THE ANALYSIS OF THE EFFECTS OF DIRECT COMPUTER EXPOSURE ON COMPUTER ANXIETY AS APPLIED TO GENERAL COMPUTER CONCEPTS IN A POSTSECONDARY SETTING

BY

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This dissertation is dedicated to my family and friends for their enduring encouragement and support

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This study expanded on the theory of anxiety (computer) by examining the effects of variations of direct computer exposure on anxiety and achievement. Direct computer exposure time was determined by how much class time was spent with the students directly in front of the computer. The impact of other factors--gender, age, the reason why one took the course, and time--on computer anxiety and anxiety over time were also examined.

Postsecondary class formats are generally determined by availability of facility and faculty with a typical 3-hour course either combining classroom lecture and computer laboratory times to varying degrees or strictly using the computer laboratory. A widely accepted theory that exposure to a task is

directly proportional to performance does not seem to factor into scheduling of all classes. If this direct exposure to a computer impacts learning and performance, then it should be a factor in scheduling computer courses.

Subjects came from a one-semester introductory computer course at a North Central Florida community college. Direct exposure was defined by class format (100%, 50%, and 33.33%) and subject was grouped by the class in which he/she was enrolled. Anxiety was measured three times over the semester using the State Trait Anxiety Inventory. Prior computer knowledge and achievement were measured using the General Computer Knowledge Inventory.

Results revealed three significant findings: (a) achievement was significantly affected by different direct exposure times, (b) anxiety did significantly reduce over time, and (c) there were significant anxiety differences due to one's reason for enrolling in the course. Findings regarding gender differences, age differences, and type of class regarding direct computer exposure time showed no significant effect on anxiety or anxiety over time.

CHAPTER 1
INTRODUCTION

The Theory of Anxiety

Pounding heart, flushed face, sweaty palms, churning stomach, rising blood pressure--these symptoms are physiological manifestations of the phenomenon called anxiety which is usually provoked when one perceives a situation as threatening (Highland, 1981). The construct of anxiety is considered a product of the 20th century and has "emerged as a central problem and predominant theme of modern life" (Spielberger, 1972, p.5). When Spielberger wrote his book in 1972, he estimated that, since 1950, over 5,000 articles and books had been written about anxiety. This resulted in a deluge of literature and a "diversity of theoretical orientations" within a 20-year span. These decades also brought about the development of psychometric instruments to assess fear and anxiety in adults, followed by self-report scales to measure general and test anxiety in children (Spielberger, 1972, p.6).

Although anxiety has been studied for nearly a century, there is still no theoretical or methodological consensus for a definition (Cambre & Cook, 1985). Spielberger's 1972 compilation of the trends in anxiety theory and

research show that, although anxiety definitions vary, there are still common threads: the occurrence of stimuli, the perception of danger/threat, and the emotions evoked. Among the anxiety theoreticians is Spielberger who published his anxiety process theory in 1972 (Sieber, O'Neil, & Tobias, 1977). His explanation was that anxiety is learned through observation of unpleasant consequences of others' failures and/or personal experience with failure. He also introduced the concept of two types of anxiety--state (A-state), or situational, and trait (A-trait), or personality-based. The latter, trait anxiety, refers to one's proneness to perceive a "wide range of situations as dangerous or threatening. State anxiety, a temporary reaction evoked by a situation that is perceived as threatening or dangerous, involves failure or a threat to one's self-esteem" (Spielberger, 1972, p.29ff).

The anxiety process begins with the three-source evaluation of a situation: (a) one's thoughts, feelings, needs, (b) external stressors, and (c) one's trait anxiety. If the person appraises the situation as potentially stressful, then one of two reactions may occur: (a) an increase in state anxiety or (b) a defense mechanism is triggered due to a highly over-learned response toward that particular stimulus. If state anxiety increases, a host of physiological anxiety reactions including, but not limited to, increased heart rate, sweating, trembling, rising blood pressure, and nausea can be triggered. The next action depends upon the familiarity with the stimulus. If one has been exposed to the stimulus previously, then a defense mechanism to avoid or

reduce the anxiety may be evoked. If unfamiliar with the stimulus, the person may cognitively reappraise the situation until such time that the anxiety is reduced either through a redefinition of the stimulus posing no threat or an evocation of a defense mechanism to cope with, avoid, or defend the anxiety. Each perceived stressful situation either promotes or reduces the intensity of the anxiety.

When a person is faced with a new and threatening or intimidating situation, state anxiety can be evoked. The existence and/or intensity of A-state depends upon one's proneness to anxiety (a high A-trait person) and the intensity of the perceived threat. Since learning often presents new situations, anxiety is a factor in learning. The more complex the task, the more effect anxiety has upon performance (Moursund, 1976; Spielberger, 1972). New situations may involve the threat of failure or a risk to one's ego. Both of these cause elevations in A-state (Sieber et al., 1977; Spielberger, 1972). Once state anxiety is increased, the person is then preoccupied with trying to reduce the anxiety either through cognitive reappraisal or defense mechanisms. In either case, the brain is engaged with issues other than learning. Because new technologies generally involve complex tasks, the influence of anxiety on learning in those situations is an important consideration.

With the advent of computerization in the workplace, people were forced into a situation where the computer was mandated as a job tool. Researchers have shown that computer resources are underutilized and that anxiety is a

significant cause of their lack of use (Torkzadeh & Angulo, 1992). This study reported that concern in the workplace ranged from decreased work performance to sabotage. It is critical that the workforce be re-tooled to keep abreast with changes. Additionally, these new tools need to be understood and embraced by users for them to be utilized. Workplace training has taken a seemingly expeditious path and primarily focused on teaching button-pushing for job performance. However, that is not enough to reduce anxiety effectively because the worker may still have the feeling of working with a "black box" or by blind faith. Knowing what button to push may not be as comforting as also knowing why to push it and what happens if another button is accidently pressed.

There are concerns in business and industry regarding the preparation of new workers for the workplace by schools and colleges and the workplace shouldering the responsibility of training workers. The foundation of computer education which addresses computer anxiety should take place in secondary and postsecondary schools before one enters the workplace (Torkzadeh & Angulo, 1992), therefore leading one to question what preparatory actions are taken in educational settings. Before addressing that question, one must consider the setting: secondary or postsecondary and, because there are variations within each setting (e.g., for secondary schools one might consider private secular, private college preparatory, public rural, public urban, public magnet, public International Baccalaureate, or technical preparatory), how

should those be considered? This study focused on a postsecondary setting of a community college for two reasons: (a) community college preparation includes technical degrees (the student is prepared for the job market upon completion of a 2-year program), lower-division college degrees (the student is prepared to enter a 4-year college for a bachelor's degree), and the availability for those in the job market to retrain by taking courses without having to work toward a degree; and (b) a broader spectrum of students generally attends this type of college rather than at a university setting. With the setting defined, one can now look at what might be a typical introduction to computers course.

One example of an introductory computer course for users (people who will be using the computer as opposed to being computer professionals such as programmers, engineers, or analysts) consists of an overview or survey of the following topics:

- The development of computers.
- The components and associated functions of a modern computer (hardware).
- The operation of the computer (starting it, stopping it, accessing programs, and using the operating system along with a graphical-user interface).
- An introduction to concepts of typical user application software such as word processing, spreadsheets, databases, communications.

- An overview of the software development cycle (design, programming, training/documentation, maintenance/enhancements)

This type of course consists of three instructional stages for computer concepts: presentation, demonstration, and practice. Because computer equipment is expensive and classroom space may be limited, the course has typically been broken into two phases that occur on a weekly basis throughout the course. The first uses a *presentation classroom* equipped with instructional equipment (e.g., overhead projector and instructor's computer with LCD projector) to present and demonstrate concepts. The student has no direct, hands-on contact with the computer while in this phase. The second phase uses a *computer-equipped classroom* where computers are present for the students to practice the concepts. Phase two more closely approximates the way that training is conducted in the workplace; that is, the student is exposed to the computer 100% of the time because one is always directly in front of him/her.

The traditional setting described above contains a lag time between the presentation and demonstration of a concept and when the student actually gets to practice it. There could be several impacts due to this gap. Two possibilities are that the lag time (a) is needed for absorption of information or (b) represents time for forgetting and may increase anxiety thus interfering with learning. If the latter is true, then it means that the teaching process is not as effective as it could or should be. If the former is correct, then one might

surmise that training centers in the workplace are being inefficient in their training.

One way to examine the effect(s) of this lag time is to compare the traditional two-phase classroom setting which limits the student's direct exposure to the computer with one that incorporates the three phases while in a single computer-equipped classroom giving the student 100% exposure to the computer. Effectiveness can be measured in two ways: (a) achievement (posttest scores compared with pretest scores) and (b) the reduction of anxiety over time. The purpose of examining achievement is to determine if either setting has an advantage over the other regarding information processing over time. In the absence of random assignments, a baseline number (i.e., how much does one already know at the start) is necessary to examine accurately if there is a significant difference between the two setting regarding achievement. The purpose of examining anxiety, as mentioned previously, is that anxiety acts as a cognition blocker because one attends to the reduction of anxiety <u>before</u> material that is being presented. If one setting has the advantage over the other to reduce anxiety faster, then one might surmise that learning can occur sooner, thus allowing more time for the student to focus on the content rather than on reducing the blocking effects of anxiety.

Statement of the Problem

The purpose of this study was to examine, within an instructional setting, the effects of variation of direct computer exposure (the degree to which one was exposed to computers) on learning (as measured by achievement) and anxiety (as measured by state anxiety changes over time). Other factors that were investigated in relationship to their interaction with state anxiety and achievement are gender, age (traditional college age < 25 years old versus older students), course requirement (i.e., required, elective, or job-related course), and prior computer knowledge. Specific questions related to the problems are as follows

- Does the direct exposure-to-computer time affect achievement?
- Is there a significant change in anxiety over time?
- Are there significant differences in anxiety between the different direct exposure-to-computer times?
- Are there significant differences in anxiety between the different genders?
- Are there significant differences in anxiety between the different age groups?
- Is there a significant interaction between direct computer exposure times and state anxiety reduction time?

- Is there a significant interaction between gender and the time it takes for state anxiety to reduce?
- Is there a significant interaction between age and the time it takes for state anxiety to reduce?
- Is there a difference in anxiety between students who take the computer course for different reasons?
- Is there a significant interaction between the reasons students take the computer course and the time it takes for anxiety to reduce?

Justification for the Study

The primary reason for conducting this study was to address the allegations of the workplace regarding the lack of preparation of workers. This was accomplished by comparing the traditional setting that only allows partial direct computer exposure for the learner with a setting that utilizes 100% direct exposure to computers. The latter parallels the workplace's approach. It is not mentioned in the computer anxiety literature if instructional time includes hands-on exposure to computers for students. The widely accepted axiom that exposure is directly proportional to performance seems to have been overshadowed for reasons of economics and convenience. The question, though, was whether these are long-term savings or did we simply shift the

burden to the workplace. If the latter is true, then, as educators, we have not performed effectively.

Overview of the Study

The subjects for this study were students from a community college enrolled in the Introduction to Computers course (a survey course of general computer concepts). The course was a requirement in many of the degree (AS and AA) programs and may also be taken as an elective or by non-degree-seeking students. The class consisted of 45 hours of classroom contact using DOS and Windows-based computers. Topics included hardware components and how they function, operating system and Windows environment, and selected application software involving word processing, spreadsheets, and database management systems.

There were three variations of class format: (a) one weekly class meeting for three academic hours (50 minutes/hour), (b) two weekly meetings for 1.5 academic hours each, or (c) three weekly meetings consisting of 1 academic hour each. There were two computer lab situations: One was shared among two or three class sections while the other was used as a dedicated laboratory/classroom. This combination of class format and laboratory situation presented three distinct direct computer exposure times in a computer-equipped classroom: 33.33%, 50%, or 100% of course time. The balance of the time

for the first two time frames was spent in a presentation classroom without the benefit of student computers.

Instructors with similar teaching philosophies and instructional styles were used. Each had two combination or direct/combination classes. Their classes followed similar formats using similar software, projects, and testing formats.

Data gathered included gender, age, reason for taking the course, three anxiety (state and trait) ratings over the course of the 15 weeks (a standard semester length), and precourse/postcourse assessments of computer knowledge. Primary analyses include (a) an analysis of covariance with the precourse scores as a covariate and (b) repeated measures analysis of variance with factors of anxiety over time and anxiety differences between direct computer exposure time, gender, age, and course requirement status. Interactions of time with state anxiety and direct computer exposure times, gender, age, and requirement status were also analyzed.

Hypotheses

On the basis of the aforementioned premise regarding exposure being positively correlated to performance, one might hypothesize that classes with more direct computer exposure would show anxiety decreases sooner. To test this, along with other possible previously mentioned interactions, a

quasi-experimental group design will be used. The following null hypotheses will be used for purposes of statistical testing:

1. There is no significant difference in achievement between students receiving different direct exposure times.
2. There is no significant change in state anxiety over time.
3. There is no significant difference in state anxiety between students receiving different direct computer exposure times.
4. There is no significant difference in anxiety between genders.
5. There is no significant difference in anxiety between age groups.
6. There is no significant difference in anxiety between students with specific reasons for taking the course.
7. There is no significant interaction between direct computer exposure times and the time it takes for state anxiety to reduce.
8. There is no significant interaction between gender and the time it takes for state anxiety to reduce.
9. There is no significant interaction between age group and the time it takes for state anxiety to reduce.
10. There is no significant interaction between the reasons for taking the course and the time it takes for state anxiety to reduce.

Limitations and Assumptions

The first limitation was that different instructors will be used thus bringing with them their individual teaching styles, skills, and experiences. Every attempt was made to seek out instructors with similar teaching philosophies and styles, and because this course was standardized in content, text, and software, the course material was consistent between instructors.

A second limitation of this study dealt with its generalizability. Can this information be applied to other settings, ages, and geographic regions? A closely connected limitation was the convenience sample. To address these two limitations, telephone surveys of several community colleges in Florida were conducted to assess their introductory computer courses in (a) content and equipment (b) format, and (c) student population. Computer science program directors from community colleges in South, East-Central, West-Central, Central, and West Florida revealed close similarities regarding student age ranges, gender proportions, prior computer knowledge, user-oriented preference (skills to be a user rather than a programmer), and attrition rate to the student population at the community college where the study was conducted. Additionally, these sites also used DOS and Windows-based computer equipment and covered the same application software concepts (word processing, spreadsheets, and databases). Appendix B contains examples of courses from these different colleges. The findings from this

survey reduced some of the concern regarding the generalizibility and convenience sampling issues.

A major assumption for the study was that subjects would accurately respond to the questions on the anxiety survey (STAI) and the General Computer Knowledge Inventory (GCKI). In close concert with that assumption was that the instructors would properly administer the instruments.

Definitions of Terms

For purposes of clarity, the following terms from this dissertation are defined below:

Anxiety is an emotional state or condition characterized by feelings of tension, apprehension, and heightened autonomic nervous system activity.

State anxiety (A-state) is temporary or situational anxiety which can be altered depending upon the situation and exposure to anxiety-provoking stimulus.

Trait anxiety (A-trait) is permanent proneness to anxiety and is personality-based. Since trait anxiety is developed early, alteration generally occurs through trauma or counseling.

Experience level refers to the subject's prior knowledge of general computer skills as determined by a criterion-referenced pretest of items whose concepts will be taught during the Introduction to Computers course and evaluated at the conclusion of the course.

Direct computer exposure time refers to instructional time that the student actually spends in a computer-equipped classroom. It will be expressed in terms of academic hours (50 minutes/academic hour).

Traditional college age refers to students less than 25 years old.

Nontraditional college age refers to students 25 years of age or older.

Course requirement refers to the reason for taking the course: required, elective, or job-related.

Academic hour refers to a 50-minute class period.

Presentation classroom refers to a classroom that has electronic equipment (i.e., overhead projector and computer with LCD projector) used for demonstration purposes by the instructor. The purposes of this classroom are presentation and demonstration.

Computer-equipped classroom is like a training/education center which is equipped with both electronic devices for instructor presentation and demonstration, and computer equipment for the students. The purposes of this classroom are to present and demonstrate concepts, and allow the students to practice those concepts immediately.

Organization of Remaining Chapters

The remainder of this dissertation is arranged in five chapters. Chapter 2 is a literature review of computer anxiety specifically related to the research problem stated earlier in this chapter. Chapter 3 contains the data from two related pilot studies. The research methodology is in Chapter 4 with the results and respective analyses from the study in Chapter 5. The final chapter, Chapter 6, includes a discussion of the research results, conclusions, and recommendations for future research. The appendices contain copies of the instruments used for the study (State Trait Anxiety Inventory and General Computer Knowledge Inventory), information relating to the content validation of the General Computer Knowledge Inventory, and the agenda for Introduction to Computers course used for this study.

CHAPTER 2
REVIEW OF RELATED LITERATURE

What Is Anxiety?

The study of anxiety took a stronghold around mid-20th century. It was calculated that, within two decades, approximately 5,000 articles regarding anxiety had been published (Spielberger, 1972, p.6). This intensive research also brought about numerous theories that reflected the "diversity of theoretical orientations that reflect important differences in the professional training, experience, and research goals of those who work in this area" (Spielberger, 1972, p.6). In 1972, Spielberger edited a book regarding the trends of anxiety in both theory and research. As mentioned above, the definitions of anxiety are varied due to different orientations toward anxiety, but he did note that the theories had some concepts in common: the occurrence of stimuli, the perception of danger/threat, and the emotions evoked. Examples of the definitions Spielberger complied in his book are cited below.

The first, from Lazarus and Averill, defines anxiety as "an emotion based on the appraisal of fear that entails symbolic, anticipatory, and other uncertain elements" (Spielberger, 1972, p.12). Another is Epstein's definition of anxiety

as "an acutely unpleasant state of diffuse arousal following the perception of threat" which is evoked by three factors: (a) primary overstimulation, (b) cognitive incongruity, and (c) response unavailability (Spielberger, 1972, pp.12-13). Fear and anxiety are closely linked but are differentiated by what actions are evoked by the threatening circumstance. Fear involves primary overstimulation and is avoidance directed into flight. Anxiety can be thought of as unresolved fear which is accompanied by reactions such as "indecision, conflict, and external restraint" which produce cognitive incongruity and response unavailability (Spielberger, 1972, p.12ff).

A third definition of anxiety from Spielberger's book is that of Sigmund Freud. He defined anxiety as a feeling of "apprehension, tension, or dread" with possible physiological and behavioral manifestation of heart palpitations, disturbances in respiration, sweating, restlessness, tremors, and shuddering (Spielberger, 1972, p.22ff).

Spielberger (1972), a renowned student of anxiety, integrated the various anxiety definitions to that of "palpable, but transitory emotional state or condition characterized by feelings of tension and apprehension, and heightened autonomic nervous system activity" (p.23). Additionally, he expanded the concept of a single anxiety into two components: state anxiety (A-state) and trait anxiety (A-trait). State anxiety refers to "complex emotional reactions that are evoked in individuals who interpret specific situations as personally threatening" (Spielberger, 1972, p.30). A particular state exists only

for that given moment in time and at that particular intensity. Often transitory, it can recur when evoked by appropriate stimuli and can endure over time if the stimulus persists. To summarize, Spielberger (1972) defined state anxiety as a transitory, emotional state or condition of the human organism that varies in intensity and fluctuates over time which can be characterized by "subjective, consciously perceived feelings of tension and apprehension, and activation of the autonomic nervous system" (p.10).

Part of one's personality, trait anxiety can be considered enduring and contains "specifiable tendencies to perceive the world in a certain way" (Spielberger, 1972, p.31). According to Spielberger (1972), A-trait is a "relatively stable individual difference(s) in anxiety proneness, that is, to differences in the disposition to perceive a wide range of stimulus situations as dangerous or threatening, and in the tendency to respond to such threats with (aforementioned) A-state reactions" (p.29). In other words, a person with high trait anxiety would have a tendency to perceive a wide range of situations as dangerous, threatening, involving potential failure or damaging to one's self-esteem and, therefore, may have a propensity toward high state anxiety. This is less so with the person with low trait anxiety.

The theoretical assumption for trait-state anxiety is that the "arousal of anxiety involves a process or sequence of temporally ordered events initiated by either internal or external stimuli that are perceived to be dangerous or threatening" (Spielberger, 1972, p.42). External stimuli, or stressors, evoke

anxiety reactions if they are either perceived as a threat of physical danger with the result being injury or death, or a threat to one's self-esteem (including failure). Internal stimuli (thoughts, feelings, and biological needs) which cause the individual to anticipate danger or fear, evoke high A-state levels. Labeling stimuli as threatening evokes an A-state reaction. The intensity of that reaction is proportional to the amount of the perceived threat, which is, in turn, directly related to the individual's past experiences. When a stressful situation is frequently encountered, the individual may develop coping strategies or defense mechanisms to reduce the state anxiety level. People with high A-trait levels tend to perceive situations consistently as more threatening than people with low A-trait levels.

Figure 1 illustrates the process of anxiety evocation and the ensuing strategies to deal with heightened state anxiety. There are three input sources for cognitive appraisal: internal stimuli, external stimuli, and the level of anxiety proneness (A-trait) of the person. There are three possible outputs from cognitive appraisal: an increase in state anxiety, a behavior due to a nonthreatening perception, or a defense mechanism due to a highly overlearned response for that threat. If the state anxiety increases, there are three possible actions: a behavior occurs; a defense mechanism is evoked; or an internal reappraisal occurs. If the path leads to a defense mechanism, then there are two possible outcomes: Either a behavior is evoked or cognitive reappraisal occurs.

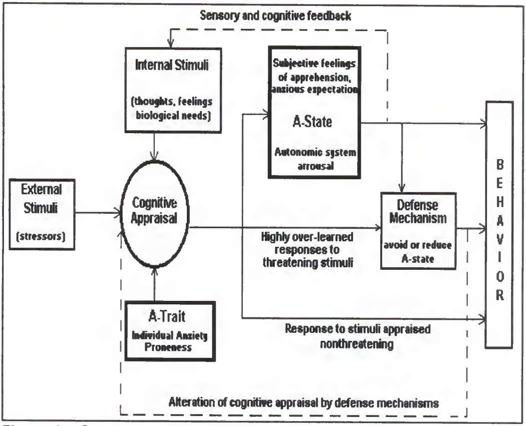

Figure 1. Spielberger's Trait-State Theory of Anxiety.

To summarize, the principal assumptions for the Trait-State Anxiety Theory are as follows:

1. A perception of a threat evokes a state anxiety reaction.
2. The intensity of the reaction is proportional to the perceived threat.
3. The duration of the anxiety is dependent upon the duration of the threatening perception.
4. Situations that involve failure or threats to self-esteem are

perceived more often by high A-trait than low A-trait individuals.

5. Increased state anxiety has stimulus(i) and drive properties that may be expressed directly in behaviors or may evoke defense mechanisms that reduced the anxiety in the past.

6. Frequently encountered stressful situations may evoke coping behaviors (defense mechanisms) in the individual to reduce the stress.

The anxiety experience can be considered a three-part process: (a) a stimulus with internal or external perceptions leading to an anxiety reaction, (b) evocation of state anxiety (fleeting), and (c) coping mechanisms (Moursund, 1976, p.295ff). The anxiety is unadulterated only for the brief moment it is initially felt. Once we begin to deal with the anxiety through coping mechanisms or behaviors to make it more comfortable, it is no longer pure. According to Moursund (1976, p.276), the four elements of anxiety are *uncertainty* (what will happen, when will it happen, what can be done about it), *helplessness* (inability to interpret or give meaning to a situation or readiness to respond with no right response), *future orientation*, and *symbolism* (symbols that gave meaning and stability no longer fit into reality). When any of these elements are in question, the result may be an increase in state anxiety.

Another way to view anxiety which is related to Spielberger's two-component definition is by subtypes (Howard, 1986, p.18): (a) rational (in proportion to the actual danger) or irrational (neurotic) and (b) permanent (trait)

or transitory (state). State anxiety is temporary or situational and can be altered depending upon the situation and exposure to the stimulus. Trait anxiety is based on one's personality. Since it is developed early, alteration generally occurs through trauma or counseling. Additionally, Howard (1986) stated that whether the perception is received subconsciously or consciously determines the type of uneasiness or stress. For example, subconscious uneasiness is expressed as tension. Once uneasiness reaches one's consciousness, it becomes, in ascending order of intensity, (a) anxiety, (b) fear (if related to the threat specifically), or (c) phobic (exaggerated fear).

The roots of stress come from three bases: psychological, knowledge, and operational. Because this dissertation deals with computer anxiety, the following examples of roots are paired with computer topics. If the stress is due to the mechanics (such as hardware components), then the root is operational. Knowledge-based stress stems from one's inability to make the machine perform or understand why it behaves the way it does. Finally, psychological-based stress comes from deep-seated personality characteristics. Howard's theory of anxiety implies that origin of the stress dictates the treatment and associated duration. Table 1 is a list of the roots of computer anxiety, their associated treatment, and times.

Table 1. Roots of Anxiety and Associated Treatment and Duration

Root:	*Psychological*	*Knowledge*	*Operational*
Treatment needed:	attitude/belief alteration	provide information	provide experience
Time for change:	long	moderate	short

The correlation of root to personality can explain the time required for change. Psychological roots are closely tied to personality and, therefore, require the longest alteration time. Operational roots have the least ties to personality and are, therefore, the easiest to modify in the shortest amount of time. Using this theory, one might surmise that, to begin the process of reducing computer anxiety, one should focus on providing computer experiences so the user can experience fast positive effects and reduction of the overall anxiety.

The two theories, Spielberger's and Howard's, have commonalities such as whether the anxiety is rooted in one's personality (trait anxiety) or is evoked by the perception of a situation (state anxiety). Howard's theory involves the concept of altering behaviors and is beyond what this dissertation examined. Therefore, Spielberger's anxiety theory (State-Trait anxiety) was the basis for this dissertation.

How Anxiety Affects Learning

Learning and problem solving, which is often incorporated into learning, have similarities when interacting with anxiety. Performance on complex problems or tasks is lowered by anxiety (Moursund, 1976, p.296ff). The learner's ability to process the new information is superseded by his/her cognitive appraisal of the stimulus which evoked the anxiety and the person's foremost attempts to reduce the anxiety. However, for easier problems, a highly anxious person will perform better than a low-anxiety person. There are three possible explanations for this. The first is that low-anxiety people become bored and lose interest with easy tasks. Conversely, the high-anxiety person is physiologically aroused resulting from the anxiety condition and continues to work. A second possible explanation is that a nonchallenging task does not represent success to the low-anxiety person, so there is no incentive to continue working. However, the high-anxiety person has fewer sources of approval so (s)he will remain on task, striving to be successful. The final hypothesis is that the task itself may "create or allay anxiety"; therefore, the A-state level is a function of problem difficulty for the high A-trait person but not the low A-trait person (Moursund, 1976, p.296).

Spielberger (1972) stated that "differences in performance of high and low A-Trait individuals on learning tasks are most often found under conditions that involve failure or ego-involving instructions" (p.37ff). Both of these

conditions elevate state anxiety, but the intensity depends upon the extent to which the situation is perceived as dangerous or threatening. "Anxiety tends to interfere with learning complex material but (in moderate degrees) does not hurt and may even facilitate learning simple things" (Moursund, 1976, p.311). Also, in situations involving high motivation or the ego, "anxious learners tend to emit a particular kind of interfering response . . . they become so preoccupied with assessing their on-going performance that they can't attend fully to the learning task itself" (Moursund, 1976, p.313ff).

Technology and Anxiety

The technological revolution began during the mid-20th century. By the 1960s, technology had an undeniable stronghold as big business began embracing computers as a way-of-life (Trainor & Krasnewich, 1992). With every advancement comes an associated set of difficulties, or hurdles, that mankind must overcome to harness the power and energy of progress. One recurring phenomenon, anxiety, comes with the advent of change, only in this case, it is called computerphobia, cyberphobia, technophobia, or computer anxiety. These coined phrases label the fear that came with the change of an industrial society into a technological society. Because of our desire to understand problems in order to solve them, the study of computer anxiety began.

Much of the research has focused on finding correlates of computer anxiety: age, gender, math anxiety, trait anxiety, locus of control, and cognitive styles. While these studies were in progress, the nature of computers and their role in society was evolving from that of data entry to information processing and digesting. According to Torkzadeh and Angulo (1992), the readiness of the workforce to fill this role became a concern. Their review of related literature revealed a "significant underutilization of computer resources and that user-anxiety played a role in this underutilization" (p.99). It has also been suggested by these authors that cyberphobia can lead to serious workplace problems, including sabotage. It is essential for society to recognize the problems and deal with effective interventions in the workplace, such as training programs that go beyond teaching button pushing performance and encompass the importance of why the button should be pressed so that users can more fully understand what is occurring, why it is happening, and further, begin tapping into the computer's potential.

Training programs in business only address a portion of the population, the workforce. What are we doing to prepare the next generations of workers? The aforementioned goal in business should be the same for education because this is where we are preparing our students for survival and, hopefully, for success in a highly technical society. As we search for ways to find how to reduce the anxiety so cognitive processing can occur, we must still be analyzing the effectiveness of what we are doing now. There is no good

justification to abandon existing processes simply for the sake of change. On the other hand, there is no good reason to perpetuate sameness based on the fact that it has "always" worked. Open-mindedness and continual re-evaluation are key factors toward maintaining effective teaching/training programs both for today and tomorrow.

Computer Anxiety and Training

Since the workplace is ultimately where our children go, examining literature regarding computer anxiety in that setting is a necessary first step in determining if schools are failing to prepare the students properly for the workplace. A primary element of automation suggested more than a decade ago was the process of accepting the technology in order to become part of that automation (McDonald, 1983). Ways to deal with this are to find forms of interventions that deal with both computer-anxious and computer-phobic people (Gardner, Young, & Ruth, 1989). This responsibility lies with the managers who often times are also victims of computer anxiety.

Torkzadeh and Angulo (1992) suggested that three phases occur for technology to be accepted: feeling (apprehension, fear, and anger at being forced to learn), thinking (a reassessment of the situation and acceptance of a new challenge), and behavior. The last phase can range from becoming committed to the technology due to success with it to rejection of the

technology due to failures. Since this is a process, training, and even education, must take the process into account because it does not diminish over generations, even with newer generations being more exposed to technologies. Training programs should focus on job-related problem solving in a step-wise manner and go beyond key-press behavior to understanding what one is doing and what is happening (Torkzadeh & Angulo, 1992). Because training is viewed as participatory, the tool being taught is incorporated into the training. The focus is on doing; concept learning is ancillary. Training is a hands-on process.

In the context of workplace training, one can identify areas that may reduce anxiety or increase acceptance: (a) recognizing the acceptance phases and developing training that works with the phases rather than ignoring or forcing them, (b) utilizing job-related problem solving in teaching one how to use the computer, thus abandoning the "button-pushing" approach, (c) teaching in a step-wise manner so as to reduce the overload of new information which can increase anxiety and thwart all efforts to reduce it, and (d) emphasizing the tool being taught with concepts being secondary. These components could be compared to preworkforce education, thus prompting the following questions: Do educational settings recognize and work with the acceptance phases? Do educational settings incorporate real-life problem solving that is relevant to the student in the curriculum? Do educational settings teach in a step-wise progression? Do educational settings focus on the use of the tool with concepts

being secondary? Evaluating these factors may help identify where the "disconnection" between education (in school) and training (in the workplace) occurs.

Computer Anxiety and Interacting Factors

Many of the volumes of literature regarding computer anxiety have focused on establishing interactions with anxiety and factors such as achievement, age, gender, previous experience, and length of exposure to computers. Literature regarding the treatment of computer anxiety has primarily spotlighted authors' experiences in undocumented situations. One longitudinal study documenting experimental treatments for the reduction of anxiety was published by Rosen, Sears, and Weil (1993). The aforementioned interacting factors described below will be the focus of this part of the literature review.

Anxiety Interactions with Learning/Achievement

To achieve successfully in any discipline, one must first be able to perceive and then process the skill(s) involved. If that processing is short-circuited, achievement is adversely affected. Anxiety has been shown to block cognitive processing and reduce performance especially when dealing with complex tasks (Sieber et al., 1977; Spielberger, 1972; Moursund, 1976).

Numerous skills must be integrated to use a computer successfully, thereby classifying computer use as a complex task. Therefore, according to Overbaugh and Reed (1990), using a computer should be considered a potential occasion for increased anxiety.

Anxiety theory proposes that computer anxiety is best viewed as a state (temporary), rather than a trait (permanent), and is, therefore, susceptible to change over time (Cambre & Cook, 1987; Margalit, Teichman, & Levitt, 1980; Moursund, 1976; Spielberger, 1966). Researchers involved in human-computer interaction have acknowledged that psychological characteristics of inexperienced computer users, such as anxiety, may affect motivation and performance (Eason & Damodaran, 1981). Loyd and Gressard (1984) supported the premise that computer anxiety, defined as fear of computers and hostile or aggressive thoughts toward computers, may inhibit successful mastery of computer skills. Marcoulides (1988) addressed the effect of computer anxiety on computer achievement and found a strong negative correlation existed between computer anxiety and computer achievement. It is well documented that, because the computer is a complex series of skills and that anxiety interferes with learning complex tasks, computer anxiety is a major obstacle in using/learning to use the computer.

Studies conducted by other researchers have shown that situational (state) anxiety can dissipate over time, allowing a person to reach a satisfactory level of achievement when using a computer (Honeyman & White, 1987;

Spielberger, 1966; Wood & Barnes, 1991). Computer achievement was found to be more a function of computer anxiety than of computer experience. In other words, given two people with divergent levels of anxiety and experience (high anxiety-low experience versus low anxiety-high experience), both people have the potential to achieve equally as well as one another, once the A-state level diminishes.

Anxiety Interactions With Age

The interaction of age with anxiety have been included in studies based on the following assumptions: Older people will be more anxious regarding computers because they are further removed from the computer revolution. However, literature regarding this interaction of age with computer anxiety are mixed. Many of the studies were conducted on students enrolled in college computer courses. Some, such as Raub (1981) and Howard, Murphy, and Thomas (1987) represented a small age range and both showed no significant age effect.

When the age range was increased such as with studies by Honeyman and White (1987), Loyd and Gressard (1984), and Wood and Barnes (1991), the results were mixed. Loyd and Gressard (1984) did find a significant age interaction with computer anxiety and experience level. It only applied to older students and at limited levels of experience. Once the experience level increased, this interaction ceased to exist.

Using similar experimental designs, Honeyman and White (1987) and Wood and Barnes (1991) conducted studies on college students whose age ranges were from 22 to 46 and 16 to 50 years old, respectively. Both studies found no significant relationships between subjects' ages and computer anxiety.

In contrast to those findings, Lewis (1988), studying adults in basic education classes, found small negative correlations between age and computer comfort. The age was also related to the amount of years a person had been away from school.

In addressing computer attitudes rather than anxiety, Pope-Davis and Twing (1991) found that age seemed to have a significant influence on computer attitude. A proposed explanation for the age factor may simply relate to the amount of exposure to computers that age groups have had (Pope-Davis & Twing, 1991). Familiarity and exposure can affect attitude and anxiety. One must also be cognizant of the time at which the study was conducted. The earlier studies were done during a time when computer exposure was limited. As time passes, the commonplace appearance of computers in society will certainly impact the way people regard the computer, as well as other technologies. Although exposure has increased, one is not certain that the novelty of computers is without effect, especially for the older segments of our population. For this reason, the factor of age continues to be included in studies regarding computer anxiety.

Anxiety Interaction With Gender

Similar to the interaction with age, the gender interactions with computer anxiety have been mixed. The reason for including gender with computer anxiety is that significant gender differences have been found in math anxiety, which is a close correlate to computer anxiety. Looking specifically at the attitudes of adult females toward computers Kuhn (1989) found that "the abnormal fear of computer usage suggested at times in the literature . . . was not prevalent among the subjects" (p.185). These findings are corroborated by Honeyman and White (1987), Lewis (1988), Loyd and Gressard (1984), Pope-Davis and Twing (1991), and Wood and Barnes (1991).

Cambre and Cook (1987) did find a significantly higher degree of computer anxiety for females and older subjects. However, their study was conducted with the following limitations: (a) use of an untested instrument which contained items that were adapted from other computer anxiety researchers, (b) descriptive study without a traditional experimental design, and (c) anonymous responses that did not allow for preexposure-to-postexposure differences in anxiety. Although their large sample (n=865) had much potential, the validity and reliability of the results are based on the authors' own statement: "assuming that the items used were valid measures of computer anxiety" (p.19). There are no data to convince a reader that the assumption should be considered valid, making their findings suspect.

Perhaps the gender issue can best be explained by the suggestions of Kirk (1992) and Farina, Arce, Sobral, and Carames (1991) that gender inequalities existed before computers and are perpetuated by societal inequities such as limited female role models in computer fields, sex-biased orientation of texts/software, and irrelevant administrative mandates such as requiring calculus as a prerequisite to computer courses. Because the results of collected data are not clear, gender continues to be included as an independent variable in computer anxiety studies.

Anxiety Interactions With Prior Experience/Knowledge and Length of Exposure to Computers

Several researchers have documented the reduction of computer anxiety over time. The length of time needed for this reduction and the degree of reduction varies according to the previous experience of the participant (Honeyman & White, 1987; Wood & Barnes, 1991). These researchers conducted similar studies and found a general trend that, irrespective of computer experience, state-anxiety reduction for the samples at large did occur sometime after 30 hours of exposure for a 45-hour course. Overbaugh and Reed (1990) using small samples (15 in the first study and 34 in their second study) and exposing them to computers found that even brief computer-awareness instruction can significantly reduce anxiety. Lastly, Kuhn's (1989) study of 63 females in Allied Health curricula documented that

subjects with exposure to computer literacy courses had more positive attitudes toward computers than their counterparts with no such background.

The measurements of prior experience have been self-rating/analysis types of instruments that rely upon honesty of the rater and the rater's interpretation of what is being asked. For example, the item "Have you ever taken a course on the basics of computer operation" could include a formal course, a workshop, a television show, or a video tape. Additionally, there is no definition of what the basics of computer operation include. Their validity and reliability may be in question. Perhaps measuring one's prior knowledge would be a more accurate indicator for measuring one's experience. Although this type of instrument really measures what one remembers, it has defined parameters (the questions) and may be better than placing emphasis on the mere attendance of a class whose content is undefined and without regard to achievement in that class.

Summary

The majority of computer anxiety literature focused on anxiety interactions with achievement, age, gender, previous experience, and exposure to and reduction of anxiety over time. Learning requires the ability to perceive and then process the skill(s) involved. These steps precede achievement. Anxiety inhibits perception and processing, but the form of anxiety related to

computers (state anxiety) is considered temporary and, therefore, subject to alteration which, in turn, affects achievement. Inexperience has been associated with heightened anxiety, but exposure to the source of fear can reduce it over time.

Literature regarding age and gender are conflicting. The question of the age conflict may be explained by the amount of exposure to new technologies for differing age groups and the time that the study was conducted relative to the advent of computers into schools and the business/marketplace. Gender inequalities existed before computer and may simply be perpetuated by societal inequities in computer areas.

Anxiety interactions with prior experience and length of exposure (instruction) show reduction of computer anxiety over time. The length of time needed for this reduction and the degree of reduction may vary according to the previous experience of the participant. However, regardless of where one starts on the anxiety scale, there is a general trend for anxiety to reduce. It has also been shown that people who have been exposed to computer literacy courses had more positive attitudes toward computers.

CHAPTER 3
PILOT STUDIES

The final study from this dissertation was the result of an evolution of two previous pilot studies. The first study began as a replication of the Honeyman and White (1987) study discussed in Chapter 2 and added two factors, prior computer experience and school status, to test for their interactions with anxiety and achievement. Pilot study 1 examined (a) anxiety changes over time, (b) achievement as related to computer anxiety and experience, and (c) the effects of anxiety with interacting factors such as gender, age, previous computer experience, and whether a student was attending school on a full-time or part-time basis.

Results from the initial study precipitated a second pilot study. One shortcoming that surfaced in Pilot Study 1 was the need for a better way to measure previous computer experience than self-reporting questionnaires. Another shortcoming was the manner in which achievement was measured. That measure was the student's final course grade which was much too

subjective. A question that arose from the results of the first study was whether or not the occurrence of anxiety reduction could be better pinpointed.

Pilot Study 2 sought to bridge these gaps in measuring prior knowledge and testing for achievement through the development and testing of an instrument called General Computer Knowledge Inventory (GCKI). The intention of the instrument was dual purpose: (a) as a pretest to measure prior computer knowledge and (b) as a posttest to measure achievement (pretest score subtracted from posttest score). That study also sought to identify a more exact point where anxiety reduced by adding more administrations of the anxiety instrument (the STAI). Findings from the second pilot study added to the knowledge base for the final study with (a) a validated instrument to measure computer knowledge (the GCKI) and (b) the results and serious drawbacks of administering the STAI more frequently.

Pilot Study 1

Rationale for Study

The first pilot study examined three areas related to computer anxiety: (a) anxiety changes over time, (b) achievement with computers as related to computer anxiety and experience, and (c) the interaction of certain factors with anxiety. These factors included gender, age, previous computer experience,

and school status (full-time or part-time) for community college students enrolled in an introductory computer course.

Methodology: Instrumentation

The State-Trait Anxiety Inventory (STAI) was used to measure changes in student anxiety regarding the use of the computer as the students progressed through the course. The test consisted of 40 items: 20 to assess the individual's state of computer anxiety at the present moment and 20 to assess the individual's trait anxiety. The items were responded to on a 4-point Lickert scale with 1 representing a response of "almost never" to 4 representing a response of "almost always." Items related to low anxiety, such as "I feel calm," were scored in reverse to allow a high score on either scale to represent high anxiety. The possible range for each subscale (state and trait) was 20 (lowest anxiety) to 80 (highest anxiety).

The reliability and validity of the STAI (Spielberger, Gorsuch, & Lushene, 1970) is well established with internal consistency reliability coefficients ranging from 0.83 to 0.92 for the state scores and 0.86 to 0.92 for the trait scores (Dreger, 1978). The STAI is widely accepted as " a relatively efficient, reliable, and valid way to assess individual differences in both anxiety-proneness and phenomenological experience of anxiety in normal . . . populations" (Katkin, 1978, p.1096).

Methodology: Subjects

The data for the study were collected over a semester from 116 students in several sections of an introductory computer applications course at a community college in North Central Florida. The course consisted of approximately 48 hours of instruction in content areas of (a) computer hardware components and respective functions, (b) DOS, and (c) concepts of application software. The student was given the opportunity, in class, to practice using the operating system (DOS) and a variety of application software (word processing, spreadsheet utilization, database applications, and programming). The equipment in the computer-teaching laboratory consisted of PC-DOS-based microcomputers. The remainder of the class time was spent on instruction involving lecture and demonstrations. Course materials were highly structured and consisted of (a) hands-on practice exercises and projects addressing use of computer software and (b) written quizzes, midterm exam, and final exam addressing conceptual understanding.

The sample consisted of male and female students who were both full-time and part-time students. There were 66 females (57% of the sample) and 50 males (43% of the sample); 63, or 54%, were full-time students while 53 attended school part-time, representing 46% of the sample. The students ranged in age from 16 to 50 years. The median sample age was 21 years while the mean age was 26.3 years. For full-time students, the median age

was 19 years and the mean age was 20.3 years. Part-time students had a median age of 33 years and a mean age of 33.3 years.

At the beginning of the study, the subjects self-reported their level of prior computer experience on a 5-point scale with Level 1 experience being "no previous experience" to level 5 being "very experienced." Forty-three (37%) of the students ranked themselves at Level 1. An equivalent amount of the sample ranked themselves at Level 2 (limited experience). Twenty-five students, or 22% of the sample, ranked themselves at Level 3 (some experience). Levels 4 or 5 (very experienced) netted 5 (4%) students. The descriptive data are presented in Table 2.

Table 2. Descriptive Data on the Subjects in Pilot Study 1 (n=116)

Gender:	Females: 66 (57%)		Part-time: 37			Full-time: 29
	Males: 50 (43%)		Part-time: 16			Full-time: 34
Median/Mean Age (years): 21/26.3			Part-time: 33/33.3			Full-time: 19/20.3
Prior Experience (by level):						
Gender	1	2	3	4	5	
Females	27	22	15	1	1	
Males	16	21	10	3	0	
School Status						
Full-time	19	26	14	3	0	
Part-time	24	17	11	1	1	
Total	43	43	25	4	1	
	37%	37%	22%	4%		

Methodology: Experimental Procedures

Based on a model used by Honeyman and White (1987), the entire STAI was administered at the beginning (State1, Trait1), middle (State2, Trait2), and end of the course (State3, Trait3). The questionnaire was administered during a class period that did not include a test to attempt to keep test anxiety from confounding the computer (state) anxiety measure.

Results

The correlations were generated for the factors of gender, age, experience level, school status (full-time vs. part-time), achievement, and the three state anxiety scores. These correlations are illustrated in Table 3.

Table 3. Correlation Coefficients of Variables with State Factors

Var:	*Age*	*Gender*	*Status*	*Exper*	*Achieve*	*State1*	*State2*
Age							
Gender	-.30**						
Status	.71**	-.24*					
Exper	-.07	.06	-.07				
Achieve	.10	.06	.01	.13			
State 1	.07	-.10	-.04	-.31**	-.13		
State 2	.21*	-.09	.06	-.20*	-.27**	.66**	
State 3	.07	-.01	-.05	-.11	-.21*	.64**	.66**

* $p < .05$ ** $p < .001$

The following are results from the analyses:

- Gender had no significant correlations with the state anxiety scores.
- Age had a significant positive correlation for State 2. This indicated that, at the second administration of the STAI, older subjects exhibited higher computer anxiety. This did not occur for either of the other two state scores. This finding was in agreement with the majority of studies considering the age factor as it related to computer anxiety.
- Over time, all subjects indicated lowering of computer anxiety. The exact timing of this reduction based on experience level was not clear. Subjects at experience levels 1 (no experience) and 3 (some experience) indicated no significant reduction until some time between the second and third administrations of the STAI. Subjects with limited experience (level 2) showed continual anxiety reduction over the course of the study. The results of this study are consistent with the finding of others (Cambre & Cook, 1987; Honeyman & White, 1987; Loyd & Gressard, 1984; Marcoulides, 1988) in that computer exposure relates to reduction in computer anxiety.
- Achievement also had a significant relationship with computer anxiety. The relationship was strongest at the halfway point in the course (State 2). Those subjects with lower anxiety scores, by the end of the course, had higher achievement scores. This finding was consistent with other research considering computer anxiety and computer

achievement (Marcoulides, 1988). This supports previous research in that computer achievement was more a function of computer anxiety than of previous experience.

- Difference scores for changes in the state anxiety scores, as shown in Table 4, (Honeyman & White model, 1987) allowed examination of the possible reduction of anxiety over the duration of the course. The following are the comparisons of differences:

  DIFFS1 = State 1 - State 3
  DIFFS2 = State 2 - State 3
  DIFFS3 = State 1 - State 2

  Paired *t* tests for the subjects as a whole indicated significant decreases in anxiety between each pair of difference scores, that is, there were reductions in anxiety throughout the duration of the course.

- Difference scores were compared based on the level of prior computer experience. Findings show that the changes in anxiety scores were significant over the final third of the course, indicating a significant reduction occurred after the second testing battery. (See Table 4.)
  - Level 1 subjects (those with no prior computer experience) followed the expected pattern that a longer time period would be required for computer anxiety reduction to occur. Their difference scores suggested that measurable anxiety reduction occurred sometime after the second administration of the STAI.

Table 4. Effects of Anxiety Differences and Prior Experience.

	Variable	t Score	Significant (α < .05)
Experience Level 1			
	DIFFS1	6.13	yes
	DIFFS2	4.84	yes
	DIFFS3	1.98	no
Experience Level 2			
	DIFFS1	5.08	yes
	DIFFS2	2.02	yes
	DIFFS3	2.78	yes
Experience Level 3			
	DIFFS1	3.25	yes
	DIFFS2	3.16	yes
	DIFFS3	0.25	no

- At level 2 (limited experience), all differences were significant, indicating continuous computer anxiety reduction over the semester.
- Level 3 subjects with "some experience" did not follow the pattern of continual anxiety reduction, but showed a significant shift somewhere after the second STAI administration.

Discussion

No relationships were found between computer anxiety and gender or school status. The gender issue was consistent with other research studying this factor (Honeyman & White, 1987; Loyd & Gressard, 1984; Raub, 1981), but does conflict with Cambre and Cook (1987), Lewis (1988), and Pope-Davis

and Twing (1991). Findings related to school status suggested that one's full or part-time status bore no effect on computer anxiety. This factor was not researched or discussed in any other study.

The findings of no significant relationship of age to computer anxiety are consistent with many other studies. However, age was one of the conflicting findings in the literature so these results do not support findings of Lewis (1988) and Pope-Davis and Twing (1991).

Findings related to prior experience and its reduction effect on computer anxiety support the premise by Cambre and Cook (1987), Honeyman and White (1987), Loyd and Gressard (1984), and Marcoulides (1988). Taking this one step further and viewing the 15 weeks in the light of experience, it stands to reason that the anxiety reduction would be substantiated by the end of the course, although the exact time frame was unclear.

Areas of concern from this study that need additional consideration were (a) the reliability and validity of self-reporting experience levels and (b) using one's course grade as a measure of achievement when the criteria for grading were both subjective and inconsistent. Another area of concern was that, while this study found that computer anxiety reduction occurred through exposure to the computer, the time period required was not clear. The findings suggested that the sooner anxiety reduction occurred, the sooner learning could take place. If one could more accurately pinpoint when this change occurred, then perhaps computer course instructors could adjust their curriculum and

present an anxiety-reducing atmosphere conducive to bringing about anxiety reduction sooner.

Pilot Study 2

Rationale for Study

This study was a direct result of the issues raised from the first pilot study: (a) the need for a valid and reliable way to measure previous computer experience, (b) the need for a way to measure achievement that was objective, reliable, and valid, and (c) pinpointing when anxiety significantly reduces. Pilot Study 2 conducted a reliability study of the General Computer Knowledge Inventory (GCKI) instrument to test for its use as a measure of computer experience. The other purpose of this study was to ascertain if the significant reduction in anxiety could be pinpointed through more frequent administrations of the STAI.

Methodology: Instrumentation

There were two instruments used for this study: the State Trait Anxiety Inventory (STAI) and the General Computer Knowledge Inventory (GCKI). As mentioned in the previous pilot study, the STAI was used to measure changes in subject anxiety regarding the use of the computer (state) and their general

feelings (trait anxiety). The 40-item test consisted of 20 items to assess the individual's state of computer anxiety at the present moment and 20 to assess the individual's trait anxiety. The item responses were based on a 4-point Lickert scale with 1 representing a response of "almost never" to 4 representing a response of "almost always." Low anxiety items, such as "I feel calm," were scored in reverse to allow a high score on subscales (state and trait) to represent high anxiety. The possible range for each subscale was 20 (lowest anxiety) to 80 (highest anxiety).

Internal consistency reliability coefficients ranged from 0.83 to 0.92 for the state scores and 0.86 to 0.92 for the trait scores (Dreger, 1978). The reliability and validity of the STAI (Spielberger el al., 1970) is well established and is widely accepted as " a relatively efficient, reliable, and valid way to assess individual differences in both anxiety-proneness and phenomenological experience of anxiety in normal . . . populations" (Katkin, 1978, p.1096). Appendix A contains the test form.

The second instrument, the GCKI, was developed to address the issue of a valid and reliable instrument to test prior computer knowledge and to act as measure of achievement (pretest score subtracted from posttest score). It was subjected to content validation at computer science departments in several community college sites throughout Florida. The final form consisted of 17 questions which were rated by content experts on a Lickert scale with 1 representing a high/excellent score and 10 representing a low/poor score. The

comprehensive rating for the instrument was 2. Each question was rated in three areas: (a) its relevancy to general computer concepts, (b) appropriateness of difficulty level, and (c) the degree to which the question reflects the rater's course content. The three areas resulted in mean scores of 1.33, 3.17, and 1.62, respectively (Table 5.)

Questions were nonspecific regarding hardware (e.g., IBM or MacIntosh) and software (e.g., WordPerfect, Works, or dBase). The format of the questions was multiple choice with four possible answers. The fourth choice, "don't know," eliminated guessing because it provided a correct response for subjects who did not think they knew the answer. The following are examples of questions from the GCKI:

- Hardware is . . .
- Software is . . .
- Which group represents input devices?
- What purpose does preparing (format or initialize) a floppy diskette serve?
- Some advantages of spreadsheet software over a manual spreadsheet are . . .
- In a Graphical User Interface (GUI) environment, symbols that represent processing options are called. . . .

Appendix A contains the GCKI test form. The possible range of scores on the GCKI when used as an instrument are 0 (no questions answered correctly) to 17 (all questions correctly answered).

Reliability results were not known at the initial administration of the GCKI because that administration was used to test the reliability of the instrument. The reliability coefficient was later calculated at 0.81 using Cronbach's Alpha analysis.

Methodology: Subjects and Experimental Procedures

The data were collected over a one-semester period from 87 students in four different sections of an introductory computer applications course at a community college in North Central Florida. The course consisted of 48 hours of instruction/practice time in the following content areas: hardware components and functions, system software (MS-DOS 6.2 and Windows 3.1), application software (word processing, spreadsheets, databases), and programming. The laboratories contained DOS and Windows-based computer systems.

The STAI and GCKI were administered during the first week of the course. Results from that GCKI administration were used to calculate the reliability of the instrument. The STAI was also administered during the 4th, 8th, 11th, and 15th weeks of the course in hopes of gaining a more accurate tracking of state anxiety level changes.

Results and Discussion

The attrition rate for the subjects was approximately 70% because all administrations had to be completed in order for a subject to be included in the study. The increase of two STAI administrations was costly in terms of duplicating charges, teaching time being used for administering the instrument, and subject pool. Because the increased administrations had the effect of severely depleting the sample size, the decision not to increase the amount of STAI administrations for the actual study was made.

The other primary purpose of this second pilot study was to find a valid and reliable instrument to use as a measure of both prior computer knowledge and achievement. The results of the Cronbach's Alpha analysis on the GCKI's internal reliability (reliability coefficient = 0.81) provided a reliable instrument to accomplish the aforementioned purposes.

Summary

The pilot studies resulted in two primary outcomes. The first was the development of a valid and reliable instrument that could be used as an objective measure of prior computer knowledge (General Computer Knowledge Inventory). This is essential when attempting to measure achievement because a powerful achievement measure is one that takes a knowledge base into consideration. The GCKI could then serve the dual purpose of measuring prior

computer knowledge and achievement. This instrument provided the opportunity to reexamine some of the interacting factors, especially those from Pilot Study 1 that were affected by or interacted with achievement such as gender, age, and anxiety.

The second significant outcome of the pilot studies was that the attempts to obtain a greater frequency of anxiety measures, thus possibly pinpointing anxiety changes, had such a negative impact on the sample size that the costs far exceeded the benefits. This resulted in the decision to maintain the three administrations (beginning, middle, and end of semester) of the STAI.

CHAPTER 4
METHODOLOGY

Literature regarding computer anxiety has dealt primarily with validating the theory that computer anxiety does exist and that it does inhibit learning. Additionally, factors--age, gender, prior computer knowledge, and time-to-anxiety-reduction--have been analyzed in past studies.

This study further expanded the theory of anxiety by examining the relationship that direct computer exposure has with computer anxiety. Postsecondary education class formats are generally determined by three factors: availability of facility, faculty, and number of students. A 3-hour course may either combine classroom lecture and computer laboratory times (combination course) or have all of the course taught in the computer laboratory (dedicated course). The combination courses may also vary in the amount of time spent with direct exposure to computers depending upon whether the class meets two or three times per week.

A widely accepted theory that exposure to a task is directly proportional to performance does not seem to be part of the equation for scheduling higher education classes. However, it seems logical to assume that, if we are desiring to generate a society of technologically competent people, the entry-level

course should be an auspicious beginning that sets the stage for encouraging computer use rather than providing unnecessary hurdles to overcome. Every attempt to maximize opportunities that expose the student to the instrument to be mastered, the computer, should be made. Altering the scheduling process would entail large investments of time and money and would probably mean acquiring more computer laboratories. Although the logic of the above statement seems clear, the hypothesis should be put to a test.

Testing the value of maximum exposure to computers in this study involved looking at several issues regarding anxiety and achievement in relation to direct exposure to computers. Other considerations, such as gender, age, and the reason why one takes a computer course, were also addressed. These aforementioned factors prompted the following questions for the study:

- Does the direct exposure-to-computer time affect achievement?
- Is there a significant change in state anxiety over time?
- Are there significant differences in state anxiety between the different direct exposure-to-computer times?
- Are there significant differences in state anxiety between the different genders?
- Are there significant differences in state anxiety between the different age groups?
- Is there a significant interaction between direct computer exposure times and state anxiety reduction time?

- Is there a significant interaction between gender and the time it takes for state anxiety to reduce?
- Is there a significant interaction between age and the time it takes for state anxiety to reduce?
- Is there a difference in state anxiety between students who take the computer course for different reasons?
- Is there a significant interaction between the reasons students take the computer course and the time it takes for state anxiety to reduce?

The study involved the examination of several factors. The first was the dependent variable of anxiety (state and trait). This factor was measured by the State-Trait Anxiety Inventory (STAI) which involved subjects responding to 20 questions regarding one's feelings toward computers to measure state anxiety and 20 questions regarding one's feelings in general (trait anxiety measure). The study approached anxiety from three directions: (a) the change of state anxiety over time, (b) differences of state anxiety between groups (exposure times, age, gender, and the reason for taking the computer course), and (c) the interaction of the aforementioned group factors with state anxiety over time.

The second factor, also a dependent variable, was achievement. It was examined in terms of its relationship with direct exposure to computers. The study used the General Computer Knowledge Inventory (GCKI) which consisted of 17 general computer questions concerning nonspecific hardware/software

concepts. To provide a more powerful measure of achievement, the study used the GCKI as a pretest to obtain a measure of the subjects' baseline knowledge. This was then factored out of the final achievement measure such that achievement became the difference between the baseline and the final score, or how much knowledge was gained.

Four independent variables were examined in this study. These variables were (a) gender, (b) age, (c) reason for taking the computer course, and (d) direct exposure to computer. Variables (a) through (c) were measured by subject responses to categorical questions administered at the beginning of the study. Gender was broken into the two logical groups: male and female. Age was grouped by under 25 years old (more traditional college age) and 25 years or older. The study used three groupings for the reason why one took the computer course: a requirement, an elective, or for personal gain/work-related reasons. The categorization of variable (d), the amount of direct exposure to the computer, was determined by the format of the classes (100%, 50%, or 33.33% of class time spent by the subject in front of a computer) in which a subject was enrolled at the community college where the study was conducted. Each variable was examined in terms of (a) differences between the variables' groups regarding anxiety and (b) a possible interaction between the variable and state anxiety over time.

Sample

It was important to locate a sample site which included all of the aforementioned groupings for the independent variables of age, gender, reason for taking the course, and varying course formats that included computer courses that offered both combination (regular classroom plus computer laboratory settings) and dedicated (computer laboratory was used as the classroom) course formats. The use of an introductory computer course allowed a broader spectrum of people to be included in the study instead of a narrowed sample which might be geared toward programming or specific computer applications. A community college was chosen for the following reasons:

- The student population represents a broad spectrum of the general population (age variation: 16 to 50+).
- The course may be taken (a) as a requirement for a degree or certificate (as in the technical or business departments), (b) as an elective, or (c) by any non-degree-seeking student.
- Numerous sections of the introductory computer course are taught during Fall and Spring.

The subjects were students enrolled in a single semester (15-week) Introduction to Computers course at a community college in North Central

Florida. This college offered a variety of class formats with differing direct computer exposures:

ACADEMIC HOURS IN		STUDY
CLASSROOM	LABORATORY	GROUPING
2	1	33.33%
1.5	1.5	50%
0	3	100%

The course covered hardware, system software, and application software. It used common instructional materials and software (DOS 6.2, Windows 3.1, MS Works for Windows 2.0, WordPerfect 5.1, and dBase III+). Two computer laboratories were used. They contained either IBM Model 50 or Gateway 2000 (486/66) computers.

Methodology

Two community college instructors with similar teaching philosophies, presentations, and activities were selected to administer the STAI and GCKI instruments to their classes. Appendix C contains the course content and activities followed by these instructors. Their classes were of varying direct computer exposure formats. The groups were defined by the amount of academic hours spent in direct contact with the computer. Data were collected from the college's Introduction to Computers course (CGS 1000) during a 15-week semester based on the following protocol:

- At the beginning of the course, each student was administered two instruments:

the *State Trait Anxiety Inventory (STAI)*

This 40-item questionnaire consisted of 20 questions related to feelings toward computers (state anxiety) and 20 questions of general feelings (trait anxiety). The responses were based on a 4-point Lickert scale that ranged from 1 (almost never) to 4 (almost always). The possible range of each type of anxiety score was 20 to 80 with a lower score representing less anxiety. This instrument provided a baseline of the subject's state and trait anxiety measures.

the *General Computer Knowledge Inventory (GCKI)*

This was a 17-item multiple choice test which included hardware and software-independent questions that dealt with computer concepts. Examples of questions included the following:

CPU represents
a. the computer's internal storage function
b. the computer's processing function
c. Computer Product Unit
d. Don't know

What is the purpose of secondary storage?
a. To allow the computer to run.
b. To store data and programs.
c. To expand ROM.
d. Don't know

Database management programs
a. are tools used exclusively by programmers.
b. are complex systems that organize data for storage purposes.
c. organize data thus making information manipulation easy.
d. Don't know

This administration of the GCKI provided a baseline of the subject's prior computer experience level and was used as the covariate for analysis regarding achievement within class formats.

- During the middle of the semester (approximately the 8th week of classes), the STAI was administered for the purpose of tracking state anxiety changes over time.
- During the final week of class, the STAI and GCKI were readministered for a final measure of anxiety and as a posttest achievement score, respectively.

These instruments were administered during class periods where no other test was scheduled. This reduced the possible confounding of test anxiety with computer anxiety.

Instruments

State Trait Anxiety Inventory (STAI)

The STAI was used to measure changes in student anxiety regarding the use of the computer as the students progressed through the course. The reliability and validity of the STAI (Spielberger et al., 1970) is well established.

The internal consistency reliability coefficients range from 0.83 to 0.92 for the state scores and 0.86 to 0.92 for the trait scores (Dreger, 1978). Katkin (1978) stated, "the STAI scale represents a relatively efficient, reliable, and valid way to assess individual differences in both anxiety-proneness and phenomenological experience of anxiety in normal . . . populations" (p.1096).

The 40-item test consisted of 20 questions to assess the individual's state (computer) anxiety at the present moment and 20 questions to assess the individual's trait anxiety. The item responses were based on a 4-point Lickert scale with 1 representing a response of "almost never" to 4 representing a response of "almost always." Items related to low anxiety, such as "I feel calm," were scored in reverse allowing a high score on either scale to represent high anxiety. The possible range for each subscale (state and trait) was 20 (lowest anxiety) to 80 (highest anxiety).

General Computer Knowledge Inventory (GCKI)

The GCKI was developed by the author and tested during 1993 and 1994 at computer science departments in several community college sites throughout Florida. It was subjected to a series of content validation tests with the final form consisting of 17 questions being rated on a Lickert scale with 1 representing a high/excellent score and 10 representing a low/poor score. The comprehensive score for the instrument was 2. Each question was rated in following three areas: (a) relevancy to general computer concepts,

(b) appropriateness of the difficulty level, and (c) the degree to which the question reflected the rater's course content. Mean scores for the three areas were 1.33, 3.17, and 1.62, respectively (Table 5).

Questions were not specific to a type of hardware (e.g., IBM or MacIntosh) or software (e.g., WordPerfect, Works, or dBase). The format of the questions was multiple choice with four possible answers. The fourth choice was always "don't know." Its presence was to eliminate guessing because it provided a correct response for subjects who did not think they knew the answer. Examples of GCKI questions are below.

- Hardware is . . .
- Software is . . .
- Which group represents input devices?
- What purpose does preparing (format or initialize) a floppy diskette serve?
- Some advantages of spreadsheet software over a manual spreadsheet are . . .
- In a Graphical User Interface (GUI) environment, symbols that represent processing options are called . . .

The possible range of scores on the GCKI instrument are 0 (no questions answered correctly) to 17 (all questions correctly answered).

Table 5. General Computer Knowledge Inventory Content Validation Data

Lickert scale 1 (high/excellent) to 10 (low/poor)			
Area Rated	*Mean Rating*	*Minimum score*	*Maximum score*
Relevancy to general computer concepts	1.33	1.0	2.4
Appropriate difficulty level	3.17	2.4	4.33
Degree to which this reflects course content	1.62	1.4	2.2
Comprehensive rating	2.0	1.0	3.0

Appendix A contains additional information regarding the content validation.

A reliability study for the GCKI was undertaken at a community college using 87 students from four Introduction to Computers sections. The internal consistency coefficient, 0.81, was calculated using Cronbach's alpha (Table 6).

Data Analysis

The data were analyzed for achievement (posttest GCKI) by conducting an analysis of covariance with the pretest score from the GCKI as the co-variate and direct exposure-to-computer as the grouping variable. Anxiety was analyzed using a repeated measures analysis of variance. Analyzed factors included (a) state anxiety change over time, (b) direct computer exposure times, genders, and ages, and (c) interactions of state anxiety over time with direct

computer exposure times, gender, age, and reasons for taking the course. Other appropriate follow-up tests were conducted as necessary.

Table 6. Reliability Data for General Computer Knowledge Inventory (n=87)

Item	*RESPONSES* *A*	*B*	*C*	*D*	*# Right*	*# Wrong*	*Item Variation*
1	6	27	34	19	27	60	0.214
2	9	60	8	10	60	27	0.214
3	1	20	55	11	55	32	0.233
4	37	16	4	30	37	50	0.244
5	24	2	3	58	24	63	0.200
6	18	58	3	8	58	29	0.222
7	8	63	2	14	63	24	0.200
8	0	1	64	22	64	23	0.194
9	3	2	46	36	46	41	0.249
10	3	51	9	24	51	36	0.243
11	36	11	3	37	36	51	0.243
12	2	4	52	29	52	35	0.240
13	38	22	1	26	38	49	0.246
14	21	18	8	40	18	69	0.164
15	1	20	29	37	29	58	0.222
16	70	0	2	15	70	17	0.157
17	15	25	10	37	25	62	0.205

Total item variance = 3.690
Test Variance = 15.395
Reliability (Cronbach's alpha) = 0.808

Summary

The study was conducted to address issues of computer anxiety relative to one's (a) amount of direct exposure to a computer, (b) gender, (c) age, and (d) reason for taking the course. The data collection spanned one semester (15 weeks) using students enrolled in an Introduction to Computers course at a community college in North Central Florida. Groups were defined by the amount of direct-exposure-to-computer time for which their class was scheduled. The State-Trait Anxiety Inventory (STAI) was administered three times over the course of the semester--weeks 1, 8, and 15--to measure anxiety changes. The General Computer Knowledge Inventory (GCKI) was administered as a pretest during week 1 of the semester to assess existing computer concepts. The GCKI was also administered during the final week of classes as a posttest to measure achievement. Other data collected included gender, age (traditional and nontraditional college age), and the reason why the student enrolled in the course (a requirement, an elective, or for personal gain or work-related reasons).

CHAPTER 5
RESULTS AND DATA ANALYSIS

The data were collected over a 15-week period from three formats of direct computer exposure classes. In order for a student to be used as a subject, all three administrations of the STAI and both GCKI tests needed to be completed. The attrition rate of subjects was due either to not meeting the above-stated criteria or withdrawing from the course.

Descriptive Data

Complete data sets were collected from 45 students in several sections of an Introduction to Computers course at a North Central Florida community college (Table 7). There were 26 females (57.8% of the sample) and 19 males (42.2% of the sample). Age was separated into two categories: (a) under 25 years of age which represented a more traditional college-aged student and (b) 25 years or older. The two age categories were evenly divided. There were 23 traditional-college-age subjects (under 25 years of age) and 22 subjects in the nontraditional (25-or-older) age category (51.1% and 48.9% of the sample, respectively.)

Table 7. Descriptive Subject Data (n=45)

Gender	*Females:* *Males:*	26 (57.8%) 19 (42.2%)
Age Groups	*< 25 years old:* *25+ years old:*	23 (51.1%) 22 (48.9%)
Reasons for taking Introduction to Computers	*Degree requirement:* *Elective:* *Personal/work:*	23 (51.1%) 8 (17.8%) 14 (31.1%)
Subjects by class formats (% of direct computer exposure)	*100%:* *50%:* *33.33%:*	13 (28.9%) 18 (40.0%) 14 (31.1%)

The study asked subjects to indicate one of three possible reasons for which one could enroll in an introductory computer course: (a) as a degree/certificate requirement, (b) as an elective, and (c) for personal gain/work related. Twenty-three of the subjects (51.1% of the sample) indicated they were enrolled in the course because it was either a degree or certificate requirement. Those selecting it as an elective, eight subjects, made up 17.8% of the sample. Fourteen subjects, or 31.1% of the sample, chose to take the course for personal gain or work-related reasons.

Data regarding class format (100%, 50%, or 33.33% of instruction time spent in a fully equipped computer classroom) revealed that 18 subjects, or 40% of the sample, had their instruction in the computer classroom half of the time (50% group). Thirteen subjects met solely in the computer classroom (100% group) for their instruction. This made up 28.9% of the sample. Those

exposed to computers one-third of their instructional time numbered 14 (31.1% of the sample).

Results of Instrument Administrations

The State-Trait Anxiety Inventory was administered three times over the course of the semester (week 1, week 8, and week 15). The trait anxiety mean scores were consistent at approximately 36 with standard deviations of 8.91, 11.0, and 11.5, respectively, over the three administrations. This validates the theory that trait anxiety was consistent across time.

State anxiety mean scores indicated a decrease in anxiety over time. The initial state anxiety (S1) mean began at 40.57 (standard deviation = 10.23) and reduced to 37.20 (standard deviation = 12.71) as measured by the second STAI administration (S2). By the final STAI measure (S3), mean state anxiety had dropped to 34.53 (standard deviation = 11.01). The minimum score also showed a downward trend from S1 to S3 with the scores declining from 21 (S1) to 20 for both S2 and S3. The maximum score demonstrated a roller coaster effect with S1 starting at 67, climbing to 73 for S2, and falling to 69 for S3 (Table 8). Caution should be taken regarding the value of the range scores as they represent individuals rather than the total sample.

Table 8. Results of the State-Trait Anxiety Inventory

n=45			RANGE	
Variable	Mean	Standard Deviation	Minimum	Maximum
Trait 1 (T1)	35.64	8.91	21	65
Trait 2 (T2)	36.13	11.00	21	70
Trait 2 (T3)	36.02	11.50	20	68
State 1 (S1)	40.57	10.23	21	67
State 2 (S2)	37.20	12.71	20	73
State 3 (S3)	34.53	11.01	20	69

The General Computer Knowledge Inventory (GCKI) was administered at the beginning of the course as a pretest (GCKI1) and at the end of the course as a posttest (GCKI2) to measure achievement. Statistics regarding these tests are in Table 9. The means of the two administrations of the GCKI are 9.49 (standard deviation = 4.07) and 13.73 (standard deviation = 2.38), respectively. The GCKI1 scores ranged from 1 correct to 17 correct. The gap narrowed considerably with GCKI2 scores ranging from 10 to 17.

Table 9. Results of the General Computer Knowledge Inventory

n=45			RANGE	
Variable	Mean	Standard Deviation	Minimum	Maximum
Pretest (GCKI1)	9.49	4.07	1	17
Posttest (GCKI2)	13.73	2.38	10	17

Data Analyses

This study tested 10 hypotheses. The first one dealt with achievement in relation to different computer exposure times. The second hypothesis tested for anxiety reduction over time. Hypothesis #3 through #6 regarded differences of grouping variables (class format, age, gender, and reason for taking the course) and state anxiety. The final four hypotheses (#7-10) were concerned with interactions of grouping variables and state anxiety reduction over time. To make it clearer to the reader, each null hypothesis is stated prior to discussing the analyses and findings.

Hypothesis #1 *There is no significant difference in achievement between students receiving different direct exposure times.*

To examine achievement, an analysis of covariance (ANCOVA) was conducted to determine if the difference between the three groups' posttest scores on the GCKI, which represented achievement, were significant after adjusting for the pretest GCKI scores. Results of the ANCOVA (Table 10) showed the direct exposure-to-computer time (represented by class format) to be significant with an F value of 14.62 ($df=2,37$ $p=.0001$). In fact, class format was the only significant variable affecting achievement.

The ANCOVA indicated that achievement was affected by direct exposure-to-computer time but did not specify which one(s) of the class

formats had significantly higher achievement. A follow-up test (least square means) adjusted out the pretest scores from the error term showing that both the 100% and 50% exposure times were significantly different for achievement from the 33.33% computer exposure time format (see Table 11). The adjusted means by class format, in terms of direct computer exposure, were 14.45 for 100% direct computer exposure format, 15.08 for 50% direct computer exposure format, and 11.32 for the 33.33% direct computer exposure format. Although the 50% format had the highest mean for achievement, it was not significantly different that the 100% format. With this analysis, hypothesis #1 was rejected because there was a significant difference in achievement based on the format of the class. Students in either the 100% or 50% formats had a significantly better chance of performing better than those students in the 33.33% format.

Table 10. Source table for Analysis of Covariance (dependent variable: posttest score; covariate: pretest score)

Source	*DF*	*Sum of Sq.*	*Mean Square*	*F value*	*Pr>F*
Model	7	146.68	20.95	7.59	0.0001
Pre	1	*0.97	0.97	0.35	0.5500
Class format	2	*80.71	40.35	14.62	0.0001
Gender	1	*4.05	4.05	1.47	0.2335
Age group	1	*0.05	0.05	0.02	0.8894
Enrollment reason	2	*1.67	0.84	0.30	0.7403
Error	37	102.12	2.76		
R-Square=0.59 *Type III SS					

Table 11. Follow-up statistics for least square means of direct computer exposure.

FORMAT (time of direct exposure to computer)	Least Square Means of Posttest
100%	14.45
50%	15.08
33.33%	11.32

SIGNIFICANCE DATA: t score (P>|t|)			
	100%	50%	33.33%
100%		-0.95 (0.3496)	4.18 (0.0002)
50%	0.95 (0.3496)		5.23 (0.0001)
33.33%	-4.18 (0.0002)	-5.23 (0.0001)	

Hypothesis #2. There is no significant change in state anxiety over time.

The second hypothesis stated that there would be no significant change in state anxiety over time. Mean state scores (Table 8) indicated a downward trend over time (40.57, 37.20, and 34.53) To test for the significance of the noted state anxiety reduction, a repeated measures analysis of variance of the state anxiety tests was conducted. Within-subject effects, as shown in Table 12, indicated a significant F value of 5.45 (df=2,76 p=.0062). Based on this analysis showing the anxiety reduction over time was significant, this null hypothesis was rejected.

Hypothesis #3. There is no significant difference in state anxiety between students receiving different direct computer exposure times.

This hypothesis used the repeated measures analysis of variance to test for the effects of different direct computer exposure formats on state anxiety. The between-subject effects from Table 12 show nonsignificance with an F value of 1.12 (df 2,38 p=.3355), thereby indicating that state anxiety was not significantly affected by the format of the class. In other words, it did not matter in which format a subject was enrolled, state anxiety functioned equally across formats; therefore, hypothesis #3 was not rejected.

Table 12. Repeated measures analysis of variance with dependent variable: state anxiety scores over three administrations (Time).

Source	*DF*	*Type III SS*	*Mean Square*	*F value*	*Pr>F*
Between-Subject Effects					
Class Format	2	426.24	213.12	1.12	0.3355
Gender	1	752.37	752.37	3.97	0.0536
Age Group	1	73.77	73.77	0.39	0.5365
Enrollment reason	2	1270.32	635.16	3.35	0.0457
Error	38	7204.02	189.58		
Within-Subject Effects					
Time	2	816.92	408.46	5.45	*0.0062
Time x Class Format	4	391.20	97.80	1.30	*0.2763
Time x Gender	2	218.24	109.12	1.45	*0.2399
Time x Age Group	2	166.84	83.42	1.11	*0.3342
Time x Enrollment Reason	4	123.98	30.99	0.41	*0.7986
Error	76	5701.17	75.02		

* Huynh-Feldt correction for violation of sphericity for the within-subject effects

Hypothesis #4. *There is no significant difference in state anxiety between genders.*

This hypothesis tested for gender differences in anxiety with the repeated measures analysis of variance. Table 12 displays the results in the between-subject effects. The F value of 3.97 (df=1,38 p=.0536) was not significant leading to the conclusion that gender does not seem to be a factor

in anxiety. Since both genders are equally anxious regarding computers, this hypothesis was not rejected.

Hypothesis #5. *There is no significant difference in state anxiety between age groups.*

The repeated measures analysis of variance test was used to determine if age was a factor in anxiety toward computers. The between-subject effects in Table 12 reveal a nonsignificant F value of 0.39 (df=1.38 p=0.5365). Since it can be concluded that anxiety toward computers was not influenced significantly by one's age, the hypothesis was not rejected.

Hypothesis #6. *There is no significant difference in state anxiety between students with specific reasons for taking the course.*

The repeated measures analysis of variance was used to determine if the reason why one enrolled in the computer course significantly affected one's anxiety. Table 12 shows a significant F value of 3.35 (df=2,38 p=0.0457) in the between-subject effects. There were three possible reasons in this study for taking the computer class: (a) as a degree/certificate requirement, (b) as an elective, and (c) for personal gain/work-related reasons. Although significance was indicated by the repeated measures analysis, the results did not indicate which reason(s) affects anxiety. To determine this, a follow-up Tuckey test was conducted. Tuckey uses all pair-wise comparisons and since there were

only three groups, doing all these comparisons would not significantly reduce the power of this follow-up test.

Results from the Tuckey test indicated a significant difference (at a 95% confidence level) in anxiety for those enrolled in the course because it was required versus those enrolled for personal gain or work-related reasons. There was no significant difference between the groups who took the class as an elective versus a requirement or for personal gain/work-related reasons. Means for the averaged state anxiety scores were 34.25 (required course), 37.25 (elective course), and 42.79 (personal/work). One could conclude that students having to take this course to meet a requirement were less likely to be anxious than those who took the course for personal gain/work-related reasons. These data signified that the null hypothesis should be rejected.

Hypothesis #7. *There is no significant interaction between direct computer exposure times and the time it takes for state anxiety to reduce.*

This hypothesis used the within-subject effects from the repeated measures analysis of variance to test for significance. Table 12 shows a nonsignificant F value of 1.30 ($df=4,76$ $p=0.2763$). This supports the hypothesis that it did not matter in which class format one was enrolled, anxiety was reduced equally. The null hypothesis was, therefore, not rejected.

Hypothesis #8. *There is no significant interaction between gender and the time it takes for state anxiety to reduce.*

The interaction of gender and state anxiety reduction was also tested using the repeated measures analysis of variance. The within-subject effects of Table 12 show a nonsignificant F value of 1.45 (df=2,76 p=0.2399). Because one's gender does not influence how state anxiety reduced over time, this hypothesis was not rejected.

Hypothesis #9. *There is no significant interaction between age group and the time it takes for state anxiety to reduce.*

The repeated measures analysis of variance (within-subject effects) in Table 12 revealed a non-significant F value of 1.11 (df 2,76 p=0.3342). Similar to the two interactions from the two previous hypotheses, age did not influence state anxiety over time. This hypothesis was, therefore, not rejected.

Hypothesis #10. *There is no significant interaction between the reasons for taking the course and the time it takes for state anxiety to reduce.*

The final hypothesis tested the interaction between the reasons for taking the course and state anxiety over time using the repeated measures analysis of variance (within-subject effects). Table 12 displays a nonsignificant F value of 0.41 (df=4,76 p=0.7986). Based on these findings, it did not

matter why one took the course because state anxiety reduced equally over time. This hypothesis, then, was not rejected.

Summary

There were 10 hypotheses tested in this study. Table 13 contains a synopsis of the findings. An analysis of covariance for achievement examined achievement in terms of pretest (covariate), class format (direct computer exposure times), gender, age groups, and reason for enrolling in the course. Class format was the only significant factor. A follow-up analysis that adjusted for the pretest showed that the significance lay between the classes that had direct computer exposure 100% or 50% of the time and the ones that only had direct computer exposure a third of the time.

Between-subject and within-subject effects regarding anxiety were analyzed with a repeated measures analysis of variance. Significance was found in the reason for enrollment (between-subjects effect) with a required course having significantly less state anxiety than if the course was taken for personal gain/work-related reasons. The other significant finding was that state anxiety decreases of over time. The significance of these findings will be discussed in the next chapter.

Table 13. Synopsis of null hypotheses with F value and probability.

HYPOTHESIS	*F VALUE*	*Probability*
1. difference in achievement by different direct exposure times	14.62	0.0001
2. change in state anxiety over time	5.45	0.0062
3. state anxiety differences due to different direct computer exposure times	1.12	0.3355
4. state anxiety differences due to gender	3.97	0.0536
5. state anxiety differences due to age	0.39	0.5365
6. state anxiety differences due to reason for taking the course	3.35	0.0457
7. interaction of direct computer exposure times with state anxiety over time	1.30	0.2763
8. interaction of gender with state anxiety over time	1.45	0.2399
9. interaction of age with state anxiety over time	1.11	0.3342
10. interaction of reasons for taking the course with state anxiety over time	0.41	0.7986

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

To add to the body of computer anxiety knowledge, this study used subjects from a community college enrolled in an introductory computer course to examine the effects of directly exposing subjects to the computer on anxiety and achievement. The impact of other factors--gender, age, the reason why one took the course, and time--on computer anxiety were also examined. Instruments testing for anxiety, the State Trait Anxiety Inventory (STAI), and prior computer knowledge/achievement, the General Computer Knowledge Inventory (GCKI), were used during the 15-week study.

Results from this study revealed three significant findings in the areas of (a) achievement based on different direct exposure times to the computer, (b) change (reduction) in anxiety over time, and (c) state anxiety differences due to why one enrolled in a course. Other findings regarding gender differences, age differences, and type of class regarding direct computer exposure time showed no significant effect on anxiety. The remainder of this chapter will focus on the findings from this study and how they relate to existing literature and their impact on how computer education and training might be approached in the future.

Achievement and Anxiety

The concept of achievement is how far one has come from where one began. The starting point is crucial in providing a powerful measure of achievement. To accomplish this strong measure, baseline (pretest) scores must first be obtained so they can be adjusted from the posttest score. This study used the GCKI as a measure of one's prior computer knowledge by administering the instrument as a pretest. The GCKI was again administered at the end of the course as a posttest. Achievement was then calculated by subtracting results of the pretest from the results of the posttest.

Achievement scores from the study indicated an increase from the pretest mean of 9.49 to a posttest mean of 13.73. This study examined achievement based on different direct exposure to computer groups: 100%, 50%, or 33.33% of class time spent directly using a computer in a 48-hour introductory computer course. When taking this view and adjusting for subjects' pretest scores, the adjusted mean scores for the groups were 14.45, 15.08, and 11.32, respectively. The adjusted means indicated significant differences between the 100% and 33.33% formats and the 50% and 33.33% formats. The conclusion drawn was that subjects enrolled in a class that allowed for 100% or 50% direct exposure time to the computer achieved more than those who were in a class that had direct computer exposure for one-third of the time.

What is the impact of this finding? A major contention of the workplace literature was that secondary and postsecondary settings were not preparing the workforce for computers because they did not necessarily help people transition through the process of accepting technology which included providing a participatory learning environment that is primarily hands-on (McDonald, 1983; Torkzadeh & Angulo, 1992). The process consists of (a) recognizing the acceptance phases and incorporating them into the learning process, (b) utilizing job-related problem solving instead of a button-pushing approach, (c) teaching these in a step-wise manner, and (d) emphasizing the tool being used. Although testing all of these components was well beyond the scope of this study, the last one, emphasizing the tool, was examined by using three different approaches toward emphasizing the tool. They were defined by how much direct time (100%, 50%, or 33.33%) was spent working with the computer. Results from this study showed that direct exposure to the computer of at least 50% of the instructional time was necessary for achieving an understanding of the tool, as measured by the posttest (General Computer Knowledge Inventory).

This result has a two-fold impact on the educational and training worlds. First, because the 33.33% direct exposure time was shown to be significantly less effective than the 50% or 100% times, educators should consider restructuring the way in which the computer classes are scheduled and allow for a course to be taught in an instructional computer classroom with

computers for all students at least of 50% of the class time. Secondly, this finding has a potential financial impact on the business world in that it does not appear to be necessary to have training courses in the computer classroom for 100% of the training time. This could mean that more training courses could be scheduled simultaneously with the instructional classroom and the computer classroom being in separate rooms, and shared between two classes. Another scenario would be that computer classrooms could be reduced in terms of the amount of workstations and split the class into instructional and hands-on times where two smaller classes could be running simultaneously and alternating the facilities.

Anxiety Changes Over Time

If anxiety impairs one's ability to learn complex tasks like the computer, how can a highly anxious person ever learn? It has been shown in previous studies that, over time, computer anxiety does diminish, thereby allowing highly anxious persons to learn and achieve as well as low-anxiety people (Honeyman & White 1987; Kuhn 1989; Overbaugh & Reed 1990; Wood & Barnes 1991). This study corroborated those findings showing that subjects' anxiety levels do reduce over time.

The body of knowledge only involves the reduction of anxiety. Questions such as how long it takes for anxiety to significantly reduce, what

triggers the significant reduction, or if the reduction can be manipulated have yet to be answered. The importance of what is known is that it relates to the premise that anxiety interferes with learning complex tasks and, until the anxiety subsides to the degree that the learner is no longer focused on reducing the anxiety, learning cannot occur (Moursund, 1976, p.297ff, p.313ff). Although this finding has been mentioned in literature for nearly a decade, it does not appear that any studies have been conducted to determine if and how anxiety can be reduced earlier to allow for learning to occur sooner. The complexities of being able to pinpoint when anxiety reduction occurs were demonstrated in the second pilot study where a severe impact on subject attrition rate resulted. Perhaps a better approach would be to examine different techniques that incorporate McDonald's (1983) and Torkzadeh's and Angulo's (1992) steps of accepting and learning technologies, as mentioned in the previous section. Determining exactly when anxiety reduces may be an impossible task as this appears to differ among subjects (Honeyman & White 1987; Wood & Barnes 1991); however, of more importance is determining effective techniques that accelerate the learning process. One could extrapolate from the degree of success of the process as to the impact on anxiety reduction since the two (anxiety and learning) are inextricably linked.

Anxiety and Reasons for Enrolling in a Course

This study examined three possible reasons why one would enroll in an introductory computer course--(a) a requirement, (b) an elective, or (c) for personal gain or work-related reasons--and whether they had any bearing on anxiety. Results indicated that people taking a course as a requirement were significantly less anxious than those taking it for personal gain or work-related reasons. Over time, however, anxiety did reduce for all groups, no matter what the reason for taking the course. Since this factor was unique to this study, there is no literature to which one can refer. There are, however, some possible explanations, all of which are pure conjecture and need to be studied.

One possible explanation for the anxiety differences between the reasons why one took the course is that those taking it for personal gain or work-related reasons were needing to improve their position at work, which may have evoked stronger anxiety than taking an introductory course for a degree. Along the same line, if the course was mandated by the boss, then that extra pressure could have evoked the anxiety. Additionally, the stake one had in the course may have provided the opportunity of increased anxiety. This is an area that really needs to be examined because the reason why one needs to learn does affect one's anxiety level and may need to be accounted for in the process of anxiety reduction for learning to occur sooner.

Anxiety and Age

Age has been thought to be an important factor in examining computer anxiety because there may need to be different approaches toward reducing the anxiety so that learning can occur. Studies regarding the effect of age on anxiety have resulted in conflicting findings. Some studies have shown that there are differences in anxiety between age groups (Lewis, 1988; Loyd & Gressard, 1984; Pope-Davis & Twing, 1991) while others, like this study, have shown that there are no significant differences in age and anxiety (Honeyman & White, 1987; Howard et al., 1987; Raub, 1981; Wood & Barnes, 1991). This study examined age and anxiety from two perspectives: (a) state anxiety differences due to age differences of two age groups (under 25 years old and 25 or older) and (b) the interaction of age with state anxiety over time. Both perspectives netted nonsignificant results, thus indicating that one's age does not affect anxiety or anxiety reduction over time. In other words, an older person is as likely to be anxious about computers as a younger person, and over time, all ages will demonstrate a reduction in anxiety, thus allowing an environment for learning regardless of one's age.

Early computer anxiety studies were conducted at a time when computers were a fairly new technology which may have meant a more dramatic shift for older people. Also, these studies represented fairly small sample sizes. Later studies with larger samples showed either no interaction

between age and anxiety, or if there was an interaction (Loyd & Gressard, 1984), then it ceased to exist over time. Because this factor continues to surface with no definitive conclusion, age should be examined in future studies to attempt to reach a clearer answer regarding age and computer anxiety.

Anxiety and Gender

Like age, the effects of gender on computer anxiety have been in conflict in the literature. A plausible explanation for this comes from Farina et al. (1991) and Kirk (1992). They suggested that gender inequities existed before computers and continue to be perpetuated through sex-biased texts and software, irrelevant administrative mandates, such as completing calculus before being allowed to take an introductory computer course, and limited female role models in the computer science area.

This study examined state anxiety differences due to gender and the interaction of gender and anxiety over time. Both of these showed nonsignificant results, indicating that both genders are equally likely to be anxious about computers and that, over time, both gender groups will experience anxiety reduction. This corroborates the findings of Honeyman and White (1987), Lewis (1988), Loyd and Gressard (1984), Pope-Davis and Twing (1991), and Wood and Barnes (1991). The primary study that found gender differences in anxiety (Cambre & Cook, 1987), lacked the use of a validated

instrument, good experimental design, and no coordination of preanxiety or postanxiety measures so the measure of anxiety change was not very robust.

The question remains as to whether gender should be included in future computer anxiety studies. It seems fairly clear that there are no gender differences, however, the data are easy to collect and analyze, so as long as there is any doubt regarding this factor and computer anxiety, it should be included in studies.

Anxiety and Class Format

This study examined an area that had not been mentioned in the literature: class format as defined by amount of direct exposure to computer in an introductory computer course. One reason for looking at this was that the literature included claims that the workplace was filled with computer-illiterate workers. The lack-of-preparation finger was pointing to secondary and postsecondary educational settings while the burden of providing on-the-job training to make up for this deficit fell on the workplace (Torkzadeh & Angulo, 1992). If classes in an educational setting could simulate the training format where workers are exposed to their tools 100% of the time during training and compared to the traditional class formats that share computer laboratories, then this claim could be partially addressed.

Another reason for examining class format was that, traditionally, class scheduling was based on facilities and faculty availability which presented differing class formats regarding the amount of time students were directly exposed to computers--33.33%, 50%, and 100% of the class time. Were each of these equally effective in reducing anxiety and promoting achievement?

Direct exposure time to computers was examined in terms of (a) state anxiety differences based on the type of class format and (b) interaction of class formats with state anxiety over time. Neither of these showed any significance to anxiety. Therefore, one could conclude that the type of class format to which one is exposed does not affect one's anxiety level. Also, for all classes, anxiety will reduce over time. Although the class format did not seem to be a factor with anxiety, it was with achievement (page 82), and the bottom line is that whatever works best should be incorporated into education or training.

Suggestions for Future Research

This study evoked several questions that need to be researched in the areas of manipulation of anxiety reduction, achievement in relation to direct exposure to computers, and motivation for learning computers as related to anxiety. Additionally, settings for studies could be broadened to range from early childhood through the workplace to determine if they are different.

The first area, anxiety reduction, should begin with identifying when the significant state anxiety reduction occurs. If this can be distinguished, then attempts to manipulate it should be made. The purpose of the manipulation would be to determine if more/better achievement can occur after state anxiety reduction has occurred. The question may be confounded with the time one needs for assimilation of information to occur. Only systematic research could clarify that.

The second area where further research is suggested concerns achievement with computers. Achievement was shown to be conversely affected by the amount of direct exposure to computers. A larger study focusing on the 50% and 100% exposure times could be conducted in a variety of settings--secondary, postsecondary, and the workplace--to determine if there truly is no significant difference between the time frames and for the different settings.

The last area for further research is motivation, or reasons behind why one takes a course. This factor needs a more in-depth examination. Perhaps dividing out the areas of personal gain and work-related reasons would provide more information regarding anxiety. Also, is there a difference if learning is required to keep one's job versus to become qualified for another job?

Summary and Conclusions

This study examined (a) achievement by class format, (b) state anxiety changes over time, and (c) age, gender, and the reason for taking a course in relation to state anxiety and anxiety changes over time. There were three significant findings. The first was that the type of class format regarding direct exposure to computer does affect achievement. This means that educational settings should rethink scheduling of classes based solely on facility and faculty availability and factor in the effectiveness of the format on achievement. It also had implications for the workplace in that the effectiveness of the format could be factored into their scheduling of classes which would present a positive financial impact as it may not be necessary to have training occur strictly in a computer laboratory setting 100% of the time.

The second finding was that anxiety does change (reduce) over time. This corroborated finding is only one piece of the puzzle as one still needs to find out if that change over time can be manipulated such that anxiety will reduce sooner to promote learning occurring sooner. Further study needs to be conducted to determine this.

The third significant finding was that the reason for enrolling in the course affected anxiety. Controlling for or manipulating this is beyond the control of an instructor or trainer. Ideally, if learners could be homogeneously

divided out by this factor, then perhaps different instructional approaches could be taken. This possibility would need to be tested further.

Other findings showed that gender and age were not factors related to anxiety. Both of these have conflicting findings in the literature and, since the data are easy to collect, they should continue to be examined in future computer anxiety studies to add more support to either side.

The class format showed an impact on achievement but not on anxiety. We know that anxiety interferes with learning (Moursund, 1976; Sieber et al., 1977; Spielberger, 1972) and that once the person is no longer preoccupied with reducing the anxiety, attention refocuses on learning. If achievement is the goal, then using the significant information regarding class format supersedes the nonsignificance of anxiety. If anxiety and learning are tightly linked, why did one show significance with class format and not the other? This question identifies the need for further study to explain this.

APPENDIX A
INSTRUMENTS USED IN THE STUDY

State Trait Anxiety Inventory

STAI PART 1.

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then CIRCLE the number of the category which best describes how you feel about computers right now. There are no right or wrong answers.

	Almost never	Some-times	Often	Almost Always
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I am strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I am frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

STAI PART 2.

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then CIRCLE the number of the category which best describes how you generally feel. There are no right or wrong answers.

	Almost never	Some-times	Often	Almost Always
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am calm, cool, and collected	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly, that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concern and interests	1	2	3	4

General Computer Knowledge Inventory

INSTRUCTIONS: Circle the letter that best answers/completes the statement/question.

1. CPU represents
   a. the computer's internal storage function
   b. the computer's processing function
   c. Computer Product Unit
   d. Don't know

2. Hardware is
   a. the CPU
   b. the computer system's equipment
   c. the computer's set of instructions
   d. Don't know

3. Software is
   a. the CPU
   b. the computer system's equipment
   c. the computer's set of instructions
   d. Don't know

4. Which type of software is required for a computer to function?
   a. system software
   b. application software
   c. utility software
   d. Don't know

5. What is the difference between batch and online processing?
   a. Batch processing is delayed; online processing is immediate.
   b. Batch processing is immediate; online processing is delayed.
   c. They are different names for the same type of processing.
   d. Don't know

6. Which group represents input devices?
   a. monitor, touch screen monitor, light pen
   b. mouse, track ball, touch screen monitor
   c. light pen, scanner, printer
   d. Don't know

7. Which group represents output devices?
   a. printer, joystick, CD-ROM
   b. printer, monitor, plotter
   c. monitor, joystick, plotter
   d. Don't know

8. ROM and RAM are
   a. both volatile
   b. both stable
   c. both types of memory
   d. Don't know

9. To activate a program, the user can either click/double click on an icon or
   a. convert it to machine language.
   b. put it on a floppy diskette.
   c. type in the command to execute it.
   d. Don't know

10. What is the purpose of secondary storage?
    a. To allow the computer to run
    b. To store data and programs
    c. To expand ROM
    d. Don't know

11. What is the purpose of primary storage (RAM)?
    a. To load programs/data for use by the CPU
    b. To supplement secondary storage
    c. To expand ROM
    d. Don't know

12. What purpose does preparing (format or initialize) a floppy diskette serve?
    a. It warms up the disk drive.
    b. It calibrates the timing of the diskette and drive.
    c. It enables the operating system to use the disk.
    d. Don't know

13. One advantage word processing software has over a typewriter is
    a. editing is made easy because the hard copy is delayed.
    b. editing is made easy because the soft copy is delayed.
    c. There is no advantage because they function identically.
    d. Don't know

14. Some advantages of spreadsheet software over a manual spreadsheet are
    a. automatic recalculation and development time
    b. automatic recalculation and data entry
    c. development time and data entry
    d. Don't know

15. Database management programs
    a. are tools used exclusively by programmers.
    b. are complex systems that organize data for storage purposes.
    c. organize data thus making information manipulation easy.
    d. Don't know

16. The information processing cycle consists of
    a. input, process, output, storage
    b. code a program, store on disk, sell to user
    c. program development, sales, user support
    d. Don't know

17. In a Graphical User Interface (GUI) environment, symbols that represent processing options are called
    a. windows
    b. icons
    c. menu options
    d. Don't know

APPENDIX B
CONTENT VALIDITY DATA FOR GENERAL COMPUTER KNOWLEDGE INVENTORY

Survey of Community College Populations

Six community colleges across Florida were surveyed to verify that the community college at which the study was to be conducted reflected (a) a typical community college population and (b) similarities in the introductory computer course regarding setup, equipment, and content. They were found to be very similar, thus making the findings from the study more generalizable to community colleges in Florida. The results are below.

Type of population

- Approximately evenly divided between the genders (male and female)
- Average age range was 16 to 50+

Course attrition rate

- Mean = 25% (range 20-30%)

Course content

48-hour, 3-credit course covering hardware components and respective functions, operating system, graphical user interface system, application software, programming concepts

Computer systems

Networked, DOS-based with Windows systems using a variety of microprocessors ranging from 80286 to 80486.

Class format

- One site used laboratory 100% of class time
- Other sites' classes had direct exposure to the computer 33.33%, 50%, or 100% of class time

Software

- DOS (ver 4.0-5.0)
- Windows 3.1
- WordPerfect 5.1 (word processing)
- Lotus 1-2-3 (spreadsheets and presentation graphics)
- dBase III+ (database management system)
- Integrated software (e.g., MS-Works or Lotus Works) for teaching word processing, spreadsheets, and databases
- BASIC (programming language)

Reasons introductory course could be taken

- as a requirement for an AA or AS degree or certificate
- as an elective for a degree/certificate program
- for credit or audit by non-degree-seeking students

GCKI Content Validity Results

Analysis of content validity ratings using Lickert scale: 1 (high/excellent) to 7 (low/poor)

1. CPU represents
   a. the computer's internal storage function
   b. the computer's processing function
   c. Computer Product Unit
   d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	3.2
Degree to which this reflects course content	1.4

2. Hardware is
   a. the CPU
   b. the computer system's equipment
   c. the computer's set of instructions
   d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	3.2
Degree to which this reflects course content	1.4

3. Software is
   a. the CPU
   b. the computer system's equipment
   c. the computer's set of instructions
   d. Don't know

RATING:

Relevancy to general computer concepts	5
Appropriate difficulty level	3.2
Degree to which this reflects course content	1.4

4. Which of the following software is required for a computer to function?
   a. system software
   b. application software
   c. utility software
   d. Don't know

RATING:

Relevancy to general computer concepts	1.2
Appropriate difficulty level	3.6
Degree to which this reflects course content	1.6

5. What is the difference between batch and online processing?
   a. Batch processing is delayed; online processing is done immediately.
   b. Batch processing is done immediately; online processing is delayed.
   c. They are different names for the same type of processing.
   d. Don't know

RATING:

Relevancy to general computer concepts	1.67
Appropriate difficulty level	3.67
Degree to which this reflects course content	1.67

6. Which group represents input devices?
   a. monitor, touch screen monitor, light pen
   b. mouse, track ball, touch screen monitor
   c. light pen, scanner, printer
   d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	3
Degree to which this reflects course content	1.4

7. Which group represents output devices?
   a. printer, joystick, CD-ROM
   b. printer, monitor, plotter
   c. monitor, joystick, plotter
   d. Don't know

RATING:

Relevancy to general computer concepts	1.4
Appropriate difficulty level	3
Degree to which this reflects course content	1.6

8. ROM and RAM are
   a. both volatile
   b. both stable
   c. both types of memory
   d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	2.8
Degree to which this reflects course content	1.4

9. To activate a program, the user can either click/double click on an icon or
   a. convert it to machine language.
   b. put it on a floppy diskette.
   c. type in the command to execute it.
   d. Don't know

RATING:

Relevancy to general computer concepts	2
Appropriate difficulty level	2.6
Degree to which this reflects course content	2.2

10. What is the purpose of secondary storage?
    a. To allow the computer to run
    b. To store data and programs
    c. To expand ROM
    d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	2.8
Degree to which this reflects course content	1.4

11. What is the purpose of primary storage (RAM)?
    a. To load programs/data for the CPU
    b. To supplement secondary memory
    c. To expand ROM
    d. Don't know

RATING:

Relevancy to general computer concepts	1.8
Appropriate difficulty level	3
Degree to which this reflects course content	2.2

12. What purpose does preparing (format or initialize) a floppy diskette serve?
    a. It warms up the disk drive
    b. It calibrates the timing of the diskette and drive
    c. It enables the operating system to use the disk
    d. Don't know

RATING:

Relevancy to general computer concepts	1.2
Appropriate difficulty level	2.4
Degree to which this reflects course content	1.4

13. One advantage word processing software has over a typewriter is
    a. editing is made easy because the hard copy is delayed.
    b. editing is made easy because the soft copy is delayed.
    c. There is no advantage because they function identically.
    d. Don't know

RATING:

Relevancy to general computer concepts	2.4
Appropriate difficulty level	3.8
Degree to which this reflects course content	2.4

14. Some advantages of spreadsheet software over a manual spreadsheet are
    a. automatic recalculation and development time
    b. automatic recalculation and data entry
    c. development time and data entry
    d. Don't know

RATING:

Relevancy to general computer concepts	1.4
Appropriate difficulty level	3
Degree to which this reflects course content	1.4

15. Database management programs
    a. are tools used exclusively by programmers.
    b. are complex systems that organize data for storage purposes.
    c. organize data thus making information manipulation easy.
    d. Don't know

RATING:

Relevancy to general computer concepts	1.2
Appropriate difficulty level	2.6
Degree to which this reflects course content	1.4

16. The information processing cycle consists of
    a. input, process, output, storage
    b. code a program, store on disk, sell to user
    c. program development, sales, user support
    d. Don't know

RATING:

Relevancy to general computer concepts	1.33
Appropriate difficulty level	3.67
Degree to which this reflects course content	1.67

17. In a Graphical User Interface (GUI) environment, symbols that represent processing options are called
    a. windows
    b. icons
    c. menu options
    d. Don't know

RATING:

Relevancy to general computer concepts	1
Appropriate difficulty level	4.33
Degree to which this reflects course content	1.67

COMPREHENSIVE RATING: 2

Combined Ratings for All Questions	MEAN	MIN	MAX
Relevancy to general computer concepts	1.33	1	2.4
Appropriate difficulty level	3.17	2.4	4.33
Degree to which reflects course content	1.62	1.4	2.2

APPENDIX C
COURSE CONTENT FOR THE STUDY

Topics covered during the study

- Evolution of Computers
- Computer components--input and output devices, storage media, processor
- Communications
- System Software (DOS)
- Overview of Microsoft WINDOWS 3.1 as it relates to use of windows, dialog boxes, and file manager (DOS)
- Word Processing Concepts
- Spreadsheet Concepts
- Presentation Graphics from Spreadsheets
- Database Concepts
- Software Development Cycle and Programming Concepts

Software to be used during the study

- MS-DOS 6.2
    - operating system

- Windows 3.1
  - graphical user interface (GUI) to DOS and application programs
- MS Works for Windows 2.0
  - word processing (graphics-based)
  - spreadsheets
  - database (graphics-based)
  - communications
- WordPerfect 5.1
  - word processing (text-based)
- dBase III+
  - database (text-based)

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BIOGRAPHICAL SKETCH

Diane Goodman Barnes, born March 7, 1951, graduated high school in 1969 from Miami Coral Park High School. She attended Miami Dade Junior College, receiving an Associate of Arts degree in journalism in 1971. She completed her Bachelor of Arts, with honors, in psychology from the University of Florida in 1974. After marrying and moving to Alabama, she worked as a substitute teacher and social worker. She relocated in Tampa, Florida, two years later and enrolled at the University of South Florida, receiving a Master of Arts from the Colleges of Education and Social and Behavioral Sciences in 1979.

In 1979, Ms. Barnes gave birth to a daughter. The following year, she began teaching secondary school in Polk County (Bartow, Florida). Her career as a public school educator extended over the next three years and included teaching in Marion County (Ocala, Florida) and at P. K. Yonge Laboratory School (Gainesville, Florida). She then enrolled in the Curriculum and Instruction program at the University of Florida's College of Education and received her Specialist in Education with a minor in computer science in 1985. CSX Technology in Jacksonville, Florida, hired Ms. Barnes, after graduation, as a programmer/analyst responsible for programmer/user education. The following year she was promoted to begin and manage a state-of-the-art

microcomputer training center equipped with touch screen monitors and laser disk players. In 1988, after returning to Gainesville, Florida, Ms. Barnes established a computer consulting business, Training Resource Group, and taught at Santa Fe Community College as an adjunct instructor for the computer science and business departments. She has developed and delivered to large/small businesses, teachers, and college students approximately 100 workshops and courses in computer literacy, PC/MS DOS, Windows, word processing, spreadsheets, and how to use computers in education. Under the auspices of Training Resource Group, Ms. Barnes has developed (a) computer-based training tutorials for software and continuing education in the pharmacy field, (b) educational videos, and (c) training materials for personal computer and AS/400 minicomputer systems. She also managed software projects, and programmed and consulted for a variety of businesses ranging from large corporations to one-doctor medical offices.

During 1990, Ms. Barnes and her colleague, Dr. Judith B. Wood researched computer anxiety and presented their findings, in 1991, at the Florida Education and Technology Conference in Tampa and at the Eastern Education and Research Association Annual Conference in Boston. They also published their study, Computer Anxiety in Florida Community College Students, in the *Florida Technology in Education Quarterly* in 1991.

Ms. Barnes enrolled part-time in the Ph. D. program at the University of Florida in 1990 in the College of Education, Department of Instruction and Curriculum. She plans to expand her business upon completion of her Ph.D.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Elroy J. Bolduc, Jr., Chair
Professor of Instruction and Curriculum

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Jeffry A. Hurt, Cochair
Associate Professor of Instruction and Curriculum

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Mark P. Hale
Associate Professor of Mathematics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. David Miller
Associate Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as a partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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